A CIVILIAN WAR HOSPITAL

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PORTLAND HOSPITAL, BLOEMFONTEIN, 1900. [*Frontispiece.*

A CIVILIAN WAR HOSPITAL

BEING AN ACCOUNT OF THE WORK OF THE PORTLAND HOSPITAL, AND OF EXPERIENCE OF WOUNDS AND SICKNESS IN SOUTH AFRICA, 1900

WITH A DESCRIPTION OF THE EQUIPMENT, COST, AND MANAGEMENT OF A CIVILIAN BASE HOSPITAL IN TIME OF WAR

BY THE PROFESSIONAL STAFF

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WITH NUMEROUS ILLUSTRATIONS

LONDON
JOHN MURRAY, 50 ALBEMARLE STREET
1901

TO

SURGEON-GENERAL SIR W. D. WILSON, K.C.M.G.

PRINCIPAL MEDICAL OFFICER TO THE ARMY IN SOUTH AFRICA

AND TO THE

OFFICERS OF THE ROYAL ARMY MEDICAL CORPS AND THE CIVILIAN SURGEONS OF No. 3 GENERAL HOSPITAL

THIS BOOK IS DEDICATED

AS A TOKEN OF APPRECIATION OF MANY ACTS OF KINDNESS AND GOODFELLOWSHIP

PREFACE

The "Portland Hospital" was the first of the civilian hospitals to be equipped and sent to South Africa after the declaration of war in October 1899, and was probably also the first voluntary hospital attached to a British army at the front. It owed its name to the generosity and support of the Duke of Portland, and its funds were supplied by him and by two hundred and fifty other subscribers.

We have endeavoured in the following pages to describe briefly our work, to provide some information as to the equipment of a civilian war hospital, and to give a short account of our own experiences. We have also expressed our opinions on some of the many interesting questions which are associated with military medicine and surgery.

As far as bullet wounds are concerned, it has seemed to us that it is as well that all information as to the injuries caused by small-bore, high-velocity projectiles should be placed before the profession, for the use of these bullets is of very recent origin, and no doubt much yet remains to be learnt concerning their effects.

We are quite aware that our own experience is neces-

sarily very insufficient, and we publish our opinions in order to add to the knowledge now being accumulated from the reports of many observers.

We desire also to record our most hearty thanks to His Grace the Duke of Portland, and to the Honorary Secretary, Major-General the Hon. Herbert Eaton, for their constant support and generous help from first to last.

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PERSONNEL, EQUIPMENT, AND INTERIOR ECONOMY

BY

SURGEON-COLONEL KILKELLY, GRENADIER GUARDS
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CHAPTER I

PERSONNEL, EQUIPMENT, AND INTERIOR ECONOMY

In connection with the fitting out of War Hospitals it must be remembered first that there is always present the transport difficulty, and hence the lighter the hospital the quicker and the more completely will it reach its destination. Secondly, the exact nature of the hospital must be definitely determined, for, by attempting to attain too many objects the utility of the hospital will be considerably impaired. The object of medical aid in war is to evacuate from the front as quickly as possible, consistently with the greatest care and comfort to the sick and wounded. This evacuation is carried out by "Bearer Companies," "Field Hospitals," "Ambulance Trains," "Stationary Hospitals," "General Hospitals," and "Hospital Ships" to England.

"Bearer Companies" and "Field Hospitals" are essentially mobile units. They have a large transport and a light equipment—no beds, and only a few bell tents. The "Field Hospital" weighs 8 tons and will accommodate 100 patients, and can be pitched or struck and packed into waggons in about an hour. "Stationary Hospitals" (which must not be confounded with "Station" Hospitals in peace time) are more of the nature of rest camps on long lines of communication. The "General Hospital," the place to which all sick and wounded are ultimately sent, is equipped for 520 beds. It is here that all important surgical and medical treatment is carried out

with the maximum of skill and comfort attainable under the circumstances, and here the final destination of the inmates is determined, whether to "duty," "garrison duty," or "home."

The Portland Hospital Committee decided to send out to South Africa a hospital for 104 beds, equipped as a fifth section of a General Hospital, but with some considerable modifications, according to the suggestions of its Medical Staff. The hospital was afterwards increased to 130 beds for non-commissioned officers and men, and 30 for officers. It is to a description of its personnel, equipment, and interior economy that this section is devoted.

PERSONNEL (see Appendix A, including Pay).

The Committee having appointed the Medical Staff, left to us and to the Hon. Secretary, Major-General the Hon. H. Eaton, the selection of the remainder of the personnel and the purchase of the equipment. We necessarily divided our labour. The surgeons selected their surgical instruments and material, etc., whilst we were all more or less responsible for the purchase of our stores. The physicians selected their medicines and medical stores, including the X-ray and photographic apparatus, whilst to the Hon. Secretary and the Surgeon-Major in military charge was delegated the task of purchasing the bulk of the equipment.

Our personnel consisted of 2 non-commissioned officers of the R.A.M.C., 4 non-commissioned officers, and 24 men of St John's Ambulance Brigade, and 6 servants, including a Swiss cook and a female servant. Amongst our orderlies certain useful trades and professions were represented, such as: compounders, cooks, carpenters, farriers, painters, engine-fitter, sailors, clerks, steward, etc. All had obtained the first aid certificates, and many had also the "nursing" certificates, of the St John's Ambulance Association. Some were men who

had served in the Royal Marines, Royal Army Medical Corps, or Army Service Corps. Each man signed a contract (Appendix B) for six months' service. An insurance was effected at Lloyds for an annuity up to 1s. a day for each man if disabled by wounds or disease. The conditions for obtaining this pension were similar to those approved by Chelsea Pensioners' Board. Married men, especially those with families, were discouraged from joining our hospital. Each man who signed the contract was then clothed according to the scale adopted by the St John's Ambulance Association (see Appendix C, which includes supplementary issue). This scale proved afterwards to be much too small, and several of the articles were not of a sufficiently good quality, so that the kit had to be largely supplemented or replaced in Cape Colony by an issue of warm serge khaki suits, strong boots, underclothing, etc., from the Army Ordnance Corps. Too much latitude had also been allowed the men in the selection of their boots, and old and part-worn boots had been obtained, which soon became useless. Mess tins of military pattern were accidentally omitted from the original list of kit, but were obtained later and found most useful.

During the voyage out every one was examined, to ascertain if they were sufficiently protected by vaccination against smallpox. Every one was also offered the opportunity of being inoculated against enteric fever—a precaution which proved most valuable afterwards during the Bloemfontein epidemic. At the same time the various orderlies were told off for different appointments, and after the selections had been made for the so-called "staff" appointments, such as cooks, clerks, wardmaster, steward, storekeeper, compounder, etc., the whole of the remaining orderlies were divided into four sections or groups, and each section was detailed to work with one of the four sisters.

In addition to the pay of each individual as fixed by

contract, a system of "Extra-duty Pay" and "Extra Messing Allowance" was adopted. The scale for each of these was fixed at 4d. a day. Extra-duty pay was given to those who had certain extra duties to perform, such as mess waiter, postman, post-mortem orderly, etc., or who worked at their respective trades (painter, carpenter, farrier, etc.). The extra messing allowance of 4d. a day was given to every man, with the object of improving the rations allowed by Government, by the purchase of such articles as jam, fresh vegetables, butter, porridge, milk, etc., in bulk, according to the wishes of individuals, or of the various "messes" into which the personnel were grouped, and which corresponded very closely with the four ward sections.

For night duty no separate staff of night orderlies was appointed, but a system was adopted by which no orderly, even at the time of our greatest pressure, need ever be without six hours sleep. According to a roster, about a fourth to a third of the orderlies and a due proportion of sick officers' servants were detailed for each night duty in two reliefs, under a wardmaster or non-commissioned officer. The first group were ordered and seen to bed in a special tent by the night wardmaster at 7 P.M., and remained there till 1 A.M., when they were called to relieve those who were on duty during this first period. The first group would then remain on duty till 7 A.M., whilst the other group slept. At 1 A.M. a cup of cocoa and milk was given to the whole of the orderlies on night duty.

The remainder of the so-called "staff billets" were as follows:—

"Chief Wardmaster," whose duties comprised discipline, keeping roster of duties for orderlies, arrangements for meeting and sending off convoys of patients, responsibility in seeing that orders were carried out, etc. The "Steward" was responsible for requisitions for drawing of rations and diets, provision stores, and returns. Under the

PLATE I.

Caldron for Boiling Infected Linen.

Kitchen at Bloemfontein.

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steward was a staff of clerks and storekeepers for "provisions," "linen," "pack," and "ordnance" stores. The dispensary was in charge of a sergeant. An orderly was appointed to the operation theatre, X-ray apparatus, and surgical stores, which were in the care of a sister. A non-commissioned officer with some natives supervised the sanitary arrangements. Another orderly had charge of the transport vehicles and animals, and had as his assistants, a groom, a farrier, and some natives. This orderly, being an engine-fitter by trade, had also care of an engine which was used for charging the X-ray accumulator. Another of our orderlies, whose occupation was in a Water Works Company, was placed in charge of the Pasteur filter installation.

Our last, but not least in importance, "staff billets" were the cooks. We had three cooks and some assistants working in two kitchens, one for officers and nurses and the other for the patients and orderlies. In fitting out kitchens it is well to keep each kitchen in a separate building if possible, and with separate establishments and equipments.

The kitchens were divided into two portions, the one for patients and orderlies, and the other for the officers' and sisters' messes and for special foods. This division suited the capabilities of the two men in charge of their respective sections. Each section had two Swedish Bollinger ranges inside and some War Office pattern camp kettles on two rails outside the kitchen building, also a complete set of the usual cooking pots and utensils, including a set of steel nesting saucepans (Appendix L, kitchen inventory). A 40-gallon caldron was always kept full of boiling water. For night use a few portable paraffin stoves were in use. The kitchen was contained in a zinc shed building kindly erected by the Royal Engineers. Refuse pits for dry and decomposing refuse were dug behind the camp some fifty yards or more from the kitchen. A meat safe, an ice safe, and a Pasteur-

Chamberland filter completed the equipment of the hospital proper.

This Pasteur - Chamberland filter was specially constructed with a view to its carriage on a mule. It consisted of three baskets. Two of these were lined with a waterproof cloth. The third basket was intended for the pump and spare parts. Near the top of these two lined baskets was a framework supporting six collecting metal tubes, and from these were suspended some 80 Pasteur-Chamberland porcelain tubes. The six collecting tubes conveyed the water into one flexible tube leading to a vacuum delivery pump. From four to six such baskets of tubes might be connected with one vacuum and delivery pump, but we only used two such baskets. The filter was put in action by filling the baskets with water by means of buckets. Then by working the pump a vacuum was produced in the vacuum chamber and along the tubes into the porcelain cylinders, and in this way by atmospheric pressure water was filtered through the tubes into a vacuum chamber, and then out by the delivery pipe to wherever it was required.

This filter answered very well up to a certain point. It requires to have duplicate parts supplied, especially the pump, so that the filter may be divided for use in different parts of a hospital, and any part requiring repair may be immediately replaced. It should be placed on coiled springs, and if possible mounted on a small carriage so that it may be wheeled about to places as well as carried on mules as panniers. The filtering medium is one of the best that is known, and it is generally believed that it will not allow the passage of any organism; it is less brittle and harder substance than the Berkefeld, and more easily cleansed by brushing. This method of filtering the water by means of a vacuum is preferable to direct pressure as there is less strain on the apparatus; the water can be subjected first to a coarse filtration through flannel if very turbid. A large number of 3-bougie pocket filters

PLATE II.

THRESH'S DISINFECTOR.

WASHING AT BLOEMFONTEIN.

[*To face page* 9.

and water-bottles can be substituted for this larger pattern if necessary.

The system of Sanitation adopted by us was as follows:—Latrines were built for sick officers, medical officers, sisters, non-commissioned officers, men, and enteric cases. Dysenteric and enteric stools were burnt with sawdust (see Rules for Disinfection, F). All infected linen and clothing was at once soaked in perchloride of mercury or izal, and then either boiled in caldrons or steamed in Thresh's disinfector. All refuse—dry, moist, and ward slops—was carried away and buried in deep separate pits. All refuse that was capable of being so treated was burnt. Clothing of patients admitted to hospital was frequently full of lice, and was all boiled after previous soaking. All clothing that remained good after being so boiled was re-issued to the patients on discharge, and supplemented by new clothing, a stock of which we kept in hospital for this purpose.

Washing.—At Rondebosch our hospital and private washing was done by contract, but at Bloemfontein we had to make special arrangements. Anticipating difficulties, we provided ourselves at Cape Town with a stock of blue soap, 40-gallon boiler, metal baths in nests, 15-feet posts, clothes lines and clips. On arrival at Bloemfontein we engaged a dozen native women, at 2s. a day with food, to wash every day for us. A tent with a large table was also provided, where all the ironing, starching, folding, and finishing was carried on. We found this system to answer admirably.

Besides these native women, some seven or eight native men were employed in various fatigue duties about the camp, chiefly to keep it clean.

On our departure for Bloemfontein we were allowed, through the kindness of Mr Bullough, to engage two sailors from off his yacht *Rhouma.* They were of the greatest assistance to us, and did every kind of work most cheerfully and thoroughly.

Equipment.

Briefly stated, the total weight of our equipment for 160 beds was 70 tons, and the space occupied was twelve railway trucks. Including our personnel complete, two ambulances, a water-cart, six mules and three horses, twelve trucks (one of which was a bogie, and one a saloon carriage) took us all, except a small advance party of four, from Cape Town to Bloemfontein.

Our surgical and medical equipment is detailed elsewhere. The operating theatre was a tortoise tent 20 by 24 feet, with a boarded floor, and a powerful 50-candle-power oil lamp. Electric light was also available, but was not often used.

The dispensary was also a tortoise tent fitted up ingeniously by the dispenser (Staff-Sergeant MacNamara). The boxes containing the drugs were all of the same size and shape. By placing these on their sides, one on the top of another, the lids of each box could be opened downwards and each formed a sort of cupboard for the drugs it contained. The case in which the operating tables had been packed formed a most excellent dispensing table. The floor was covered with tarpaulin.

The patients' tents consisted of 13 tortoise tents, 20 by 24, and one 20 by 30, 2 ordnance store tents 60 by 30, and 8 bell tents. Each tortoise tent contained 8 patients, except the larger one which was arranged for 16. The ordnance tents contained 18 patients each, and the bell tents contained one to two patients, according to the nature of the cases—these completing a total of 160 beds.

The tortoise tent, 20 feet by 24 feet size, makes an excellent ward tent for 8 beds, although 10 beds could be easily put in. If well pitched it will keep out the heat of the sun, and it is quite water tight and will withstand heavy and prolonged rain and strong winds. Each tent requires, especially in clay soils, to be provided with four long iron pegs, 2 to 3 feet in length. The sides can be lifted up easily and thorough ventilation effected. The tortoise tent weighs

Railway Transport of Portland Hospital over Hex River Pass.

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about 320 lbs. and can be packed on two mules, being divisible into four parts of about 80 pounds each. (See Appendix H).

The ordnance store tent made a very good ward, but required to have an inner lining something like that of the tortoise tent. Flooring for these tents was a question much discussed, and we decided to use nothing except two strips of coir matting and small strips of Japanese matting. Thus, the ground could be swept daily and sprinkled with a solution of izal in water, and a most satisfactory floor was the result. Each tent was well trenched.

For inventory of equipment of a tortoise tent ward, see Appendix J. The eight beds were wooden-framed spring beds with folding legs. Each bed and mattress complete weighed 60 lbs. Although none of them broke, yet these bedsteads were liable to break unless carefully packed, and for this reason similar light, strongly-made, steel-framed, spring beds might perhaps be better, if they could be made of the same weight. In the centre of the ward was placed a table 6 feet by 3 feet, with two cupboards made from packing cases, and covered with a cretonne. Between every two beds was a bedside table. A combined diet and chart board belonged to each bed. A complete set of enamel ware and cutlery was provided for each tent, also feeding-cups, milk and water cans, brushes, etc., according to list in appendix. An officers' ward was similarly fitted up, except that china and crockery was used instead of enamel ware, and a finer quality of matting was placed on the floors.

All our provisions, linen, clothing, and gifts were kept in a large ordnance store tent divided into three parts. Empty cases were piled and arranged in a row along the centre and sides, with their open ends facing outwards, and thus an excellent set of storing shelves were constructed, and our packing cases were preserved from damage for future moves of the hospital. The pack store and ordnance clothing stores had necessarily to be in a

separate tent. The ordnance stores were arranged in a tent, and patients who had lost their clothing were re-fitted there. A strong safe was kept in the office, where all money and valuables belonging to patients were kept. Some patients have handed in sums of £50 and £60 at a time for safe custody.

The officers' mess was located in a green tortoise tent with a floor of coir matting. We arranged to have a combined mess, so that medical officers and convalescent officers and their friends should mess together. A daily menu card, which included luncheon and dinner for the day and breakfast the day following, was useful, inasmuch as sick officers on full diet, but who were not able to come to mess, could select their own food. (Specimen menus, Appendix D). The food in mess consisted of each officer's rations supplemented by extras ordered for those who might be patients, by mess stores, and by local purchases of milk, eggs, fruit, and vegetables. The mess stores from England were packed in two ways: (1) Small quantities of various foods were packed in numbered cases, and catalogued so that each case had an assortment of food. (2) Other cases were each filled with one kind of food or other stores. The former is the better method if one anticipates much movement, and the latter if the hospital is to be more stationary. A judicious combination of the two methods would be the best. There are certain articles of food which we found were in great demand, such as jams, especially Cape jams, which are of most excellent quality, oatmeal, milk, particularly unsweetened milk and Dahl's Norwegian milk, small tins of cream, pressed beef, arrowroot, cigarettes, etc. Enamel-ware plates and dishes were in stock for use during moves, but these were replaced completely, whenever we became stationary, with crockery and glass.

Each medical officer had a square bell tent to himself, and except at the very beginning each sister had a tent to herself. A "square bell" tent has four corners, which

enables the space to be economised, and by means of an upright pole of 6 feet in the doorway a great deal more head room is obtained than in an ordinary bell tent. The centre pole has sometimes a nasty way of going through the canvas and allowing the tent to subside. These tents are very good if lined. They weigh 80 lbs.

All non-commissioned officers and men had their diets served to them in their wards on diet trays, as ordered by their medical officers. Diets for patients in hospital were of two kinds. At Rondebosch, where we were near abundant supplies, the regular hospital diets and extras were issued, and the military diet sheets used (see Appendix for Diet Sheets, and Diets and Extras, E, *b*, *e*, *d*). At Bloemfontein "rations" and "extras" were issued, and from these we devised a scale of diets and extras (see Appendix E). As these were daily prescribed by the medical officers the sisters wrote down the instructions in the ward book, and each made a summary of diets and extras ordered for her section, and sent this summary in to the steward, who then requisitioned accordingly. This question of diets and extras is a much debated question. In our opinion the military system of ordering diets, if properly carried out, is a most excellent one, but the number of meals is too few. We therefore arranged for a fourth meal at about 7 P.M. as a kind of light supper, which we found to answer exceedingly well. We were fortunate in having good cooks, but if men were obtainable for war hospitals who had been thoroughly trained in a combination of "field" and "sick" cooking, and who could adapt themselves to circumstances, a most useful and valuable addition could be made to the personnel.

For local transport we had a couple of ambulances and some six to eight mules, as well as an American trap, a water cart, and riding horses. A light American General Service waggon would in addition have been very useful. This transport was utilised for the sick, for drawing rations and forage, and for transport of water.

A large number of tarpaulins, with poles 15 feet long and bolts and nuts a foot long, were very useful to us. With these we erected a bath house for men, shelters for natives, and shelters for packing cases, rough stores, and tools. Tarpaulins were also useful for floors of tents, and for quickly protecting exposed stores from rain.

There are some important points in connection with the *packing* of all this equipment that we have not yet touched upon. It is well to have some trained packers amongst the orderlies. All packing cases should be so constructed as to be capable of being utilised either as tables or cupboards. It would be useful to have these cases made in standard sizes, so that they could be built up into tiers of shelves or cupboards. They should not be too large or heavy—40 and 80 lbs. loads are the most convenient for transport.

Beds and mattresses should not be packed too many together. Not more than two beds and two mattresses should be packed together. One of our beds and mattresses alone weighed 60 lbs., and they were light.

Cases should be bound with iron, and screws used instead of nails, so that they can be removed without destroying the cases.

The name of the corps and the address should be clearly painted on each package. Each case should have a consecutive number in its own special series and distinguishing mark, and the contents should be carefully enumerated in an inventory.

These precautions, most of which we had taken when fitting out our hospital, proved of the greatest possible assistance to us and saved us no end of time, trouble, and losses afterwards. Printed labels are useful to have always ready, but are difficult to make adhere properly. We went so far as to paste labels on the railway trucks carrying our hospital, and they saved our losing two truck loads of stores.

A few suggestions as to stores may not be out of place

here as the result of our experiences: Provision should always be made for a good supply of unsweetened milk. It is perhaps in some ways better than fresh milk, for one never knows whether the latter is pure. We have on several occasions, when we were short of fresh milk, issued unsweetened milk ready mixed with water as fresh milk, and it has been invariably taken with relish, and has often not been detected as tinned milk. Some brands of milk, such as Dahl's Norwegian Sterilised Milk, are most excellent and much better than many specimens of fresh milk.

A simple laundry and portable disinfecting apparatus (such as that constructed by Messrs Defries) should if possible be established.

A spare surplus stock of palliasses, waterproof sheets, and blankets are useful to have ready in the event of the unexpected arrival of any large convoy of sick. Convalescents or those slightly wounded can then be temporarily accommodated till more room became available, and more serious cases can be examined on these temporary beds before they are allotted to their proper wards.

An agent to collect stores and send off supplies at the base of operations is a most necessary appointment to make, and will help to save much trouble and time.

Appendix M will show the dates of our arrivals and departures, and of our first and last convoys of sick. During an actual number of 180 days, when sick were in our hospital, we treated 1009 patients. We received our first convoy of 33 sick at Rondebosch on 8th January, six days after the arrival of the transport *Victorian* with our equipment. It occupied us eleven days from the day we discharged our last patients at Rondebosch on 6th April to the day we received our first at Bloemfontein, including the railway journey of six days. On the 18th July we handed over our last patients prior to our departure for England, where the hospital arrived on the 18th August 1900. During the voyage the personnel treated 82 cases (see Appendix O).

In Appendix N is a short statement of rates per cent. of sick and wounded for calculating hospital accommodation. Appendix O contains a list of kit recommended for hospital officers.

In a military hospital a large number of rules have been framed as the result of experience so as to enable the whole to work automatically, and yet maintain the chain of responsibility. One is apt to forget in the administration of a military hospital that the regiment is the soldier's home for the time being, and that he has a commanding officer, and relations and friends asking for information, and that the War Office Authorities require certain statistics on the health of our troops all over the world, so that health precautions may be adopted. Consequently there are certain correspondence records and returns which are essential. There is no doubt, however, that many returns and much correspondence might be abolished.

The aim of a Private War Hospital should be to reproduce those Military Rules and Returns, etc., that are most suitable, and omit the others.

The following are some that appear to be essential :—

"*Admission and Discharge Book*" is the basis of all returns. It gives the number, name, rank, corps, age, service, disease, date of admission, discharge or death, and remarks. In order to keep this book correctly, it is essential that these particulars should be furnished by some responsible person immediately on the admission of a patient, and that the medical officer should, in his own handwriting, name the disease according to the "Nomenclature of Diseases compiled by the Royal College of Physicians, London."

"*Diet Sheets*" are usually collected by a Wardmaster who has a "*Summary of Diets*" made (see Appendix E *c*) and sent to the steward of the hospital, who is then responsible for the drawing of diets and extras and issuing them to the cooks. For this reason the original ordering

or prescribing of diets must be accurately done by the medical officer or person he deputes.

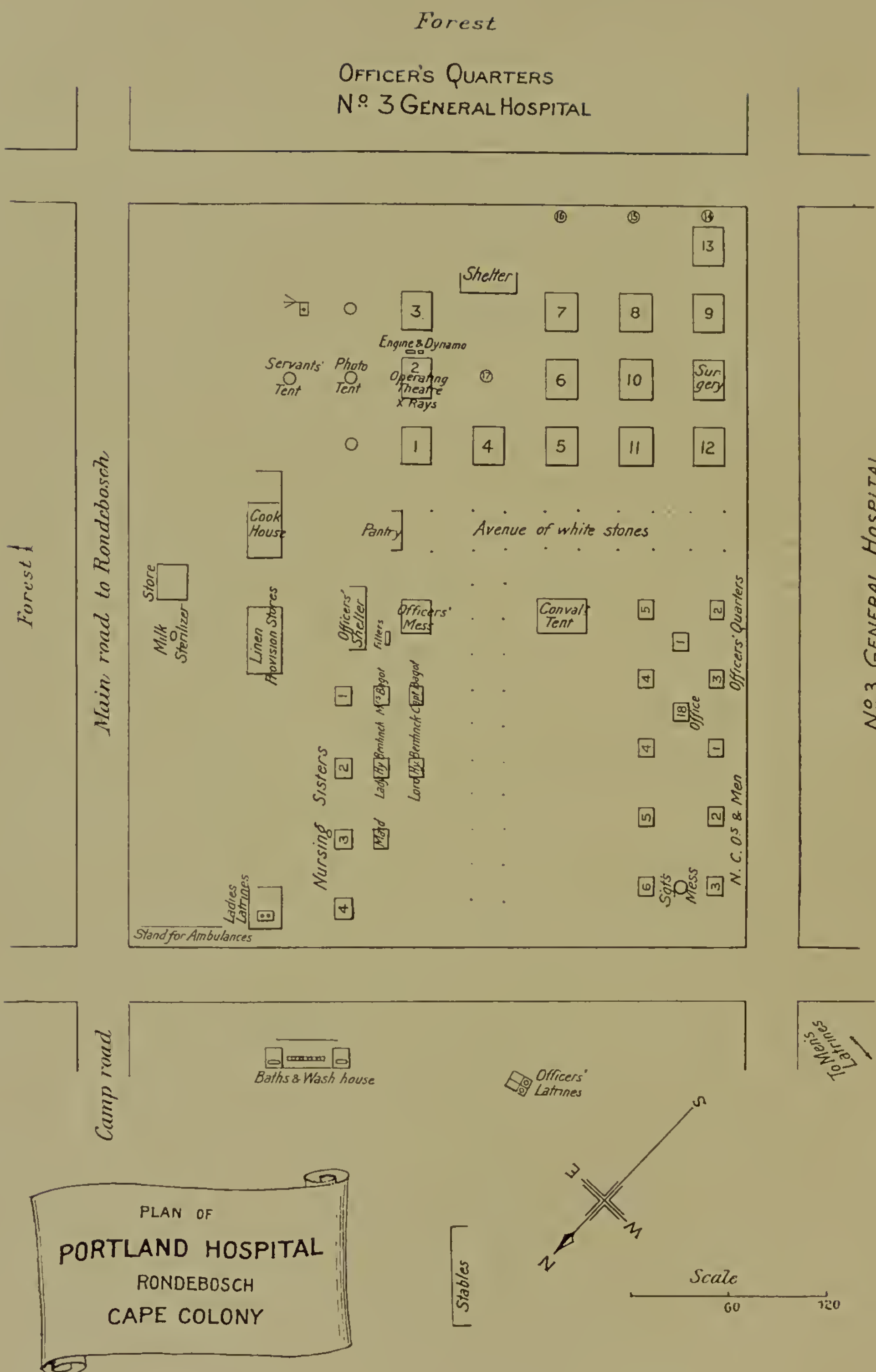
The *Weekly Return* gives a summary of the sick by diseases, and by corps, a list of officers sick, deaths, remarks on sanitation, prevalence of disease, etc. This return gives a brief review of the state of the sick in hospital and the changes they undergo from the state of the previous week.

THE CAREER AND WORK OF THE PORTLAND HOSPITAL

BY

ANTHONY BOWLBY, F.R.C.S., Senior Surgeon

PLATE IV.



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CHAPTER II

THE CAREER AND WORK OF THE PORTLAND HOSPITAL

THE Portland Hospital may be said to have commenced its career on 13th December 1899, on which day the Medical Staff and the orderlies embarked at Liverpool on the R.M.S. *Majestic*, "transport No. 68," and its work was finished when the transport *Canada*, with sick and wounded troops, arrived at Southampton on 18th August 1900. Much had happened during this time, and great events had occurred in South Africa, with very important and far-reaching results, affecting both the army as a whole and the hospitals which proved so important and necessary for the maintenance of that army in the field.

The voyage was comparatively uneventful, but the opportunity of a quiet time on board was utilised to inoculate a large number of the orderlies and staff with typhoid toxin, with results which will be found in detail later on; and for the present it is sufficient to note that, though some were for a short time rendered much more ill than others, all arrived at Cape Town in good health on 28th December, when on a lovely evening Table Bay and Mountain and the more distant peaks on the mainland looked their best in the light of the setting sun. Orders arrived for the *Majestic* to go round to Durban on the following day, so that the Hospital Staff disembarked on the morning of 30th December, the orderlies, with Surgeon-Colonel Kilkelly in command,

going to Rondebosch, and the rest of the staff joining Lord and Lady Henry Bentinck and Captain and Mrs Bagot at the hotel to which they had gone with the nurses who had accompanied them on the mail steamer which arrived three days previously.

A call on the Surgeon-General resulted in the information that the military authorities had fixed upon Rondebosch, five miles from Cape Town, as the place where the hospital should commence work, and the arrival of the transport *Victorian* with stores three days later enabled the camp to be pitched forthwith.

The situation of Rondebosch was quite ideal from every point of view. Situated on the line of railway which crosses the Cape Peninsula to Simon's Town, it was excellently served by numerous trains, and the camp was placed about a mile and a quarter from the station, on rising ground.

The soil was sandy, and fir trees grew in abundance. The camp ground had been but recently cleared of trees, and had never been built over. The houses immediately around consisted of scattered villas in their own grounds, whilst to the east was the open country called the "Sand Flats," covered mostly with small bushes and heather, and rich with flowers.

From the camp there was an uninterrupted view of Table Mountain, Constantia Nek, the Constantia Berg, and the Muizenberg, whilst the few trees which had been left here and there were subsequently found most useful by the convalescent patients as a shelter from the blazing sun in the months of January and February.

There was already an excellent water supply near at hand, which had been brought from Table Mountain to supply the houses in the neighbourhood, and the work of the Royal Engineers soon resulted in a series of stand-pipes being erected, so that there was an abundant supply for baths and wash-houses, as well as for the kitchens and the wards.

PLATE V.

TENTS OF MEDICAL STAFF AND ORDERLIES AT RONDEBOSCH.

[*To face page* 22.

We found much of the camping-ground already occupied by the tents of No. 3 General Hospital, under the command of Col. Wood, R.A.M.C., who, with his officers, received us in the most cordial manner, and treated us during the whole of our stay with the greatest possible kindness and consideration, and did their utmost to make us feel thoroughly at home. Our camping ground was separated from the hospital tents of No. 3 by one roadway, and from those of the officers by another running at right angles, so we aligned our camp by theirs and set to work to get the tents erected.

Our kit was disembarked on Tuesday, 2nd January, and was brought to the camp mainly by road, the only difficulty experienced being that the traction engines and trucks were too heavy to pass safely over a small wooden bridge near to our ground, and that all the goods had to be offloaded on to waggons before they could be brought to their destination. In spite, however, of such minor troubles all went smoothly and well, and so heartily did our men work that by Saturday, 6th January, our tents were pitched, our beds and bedding were unpacked, and our kitchen was in sufficiently good working order to enable us to announce that we were ready to receive patients forthwith.

The plan of the camp will show at a glance its general arrangement. It was divided into two separate parts by a central roadway, so that the tortoise tents for the patients lay on one side, and the square bell tents of the staff were pitched on the other. The tortoise tents were 24 feet by 20 feet and rectangular. They consisted of waterproof canvas, with a lining of thinner canvas loosely attached so as to hang in folds and leave a considerable air space between it and the outer covering. This lining and air-space made all the difference in the comfort of patients during the hot weather, and the universal opinion of officers and men alike was that the tents were very cool and comfortable. They were also very easy to ventilate thoroughly, as they were fitted with numerous small

openings for windows, and the whole of one or other side could be furled so as to open it completely to the outside air. Each tent held four beds a side, with room to place small tables between the beds and to leave a space in the middle of the tent six feet wide for a passage way, with a central table and other ward accessories. Each tent would have held ten beds instead of eight without material crowding.

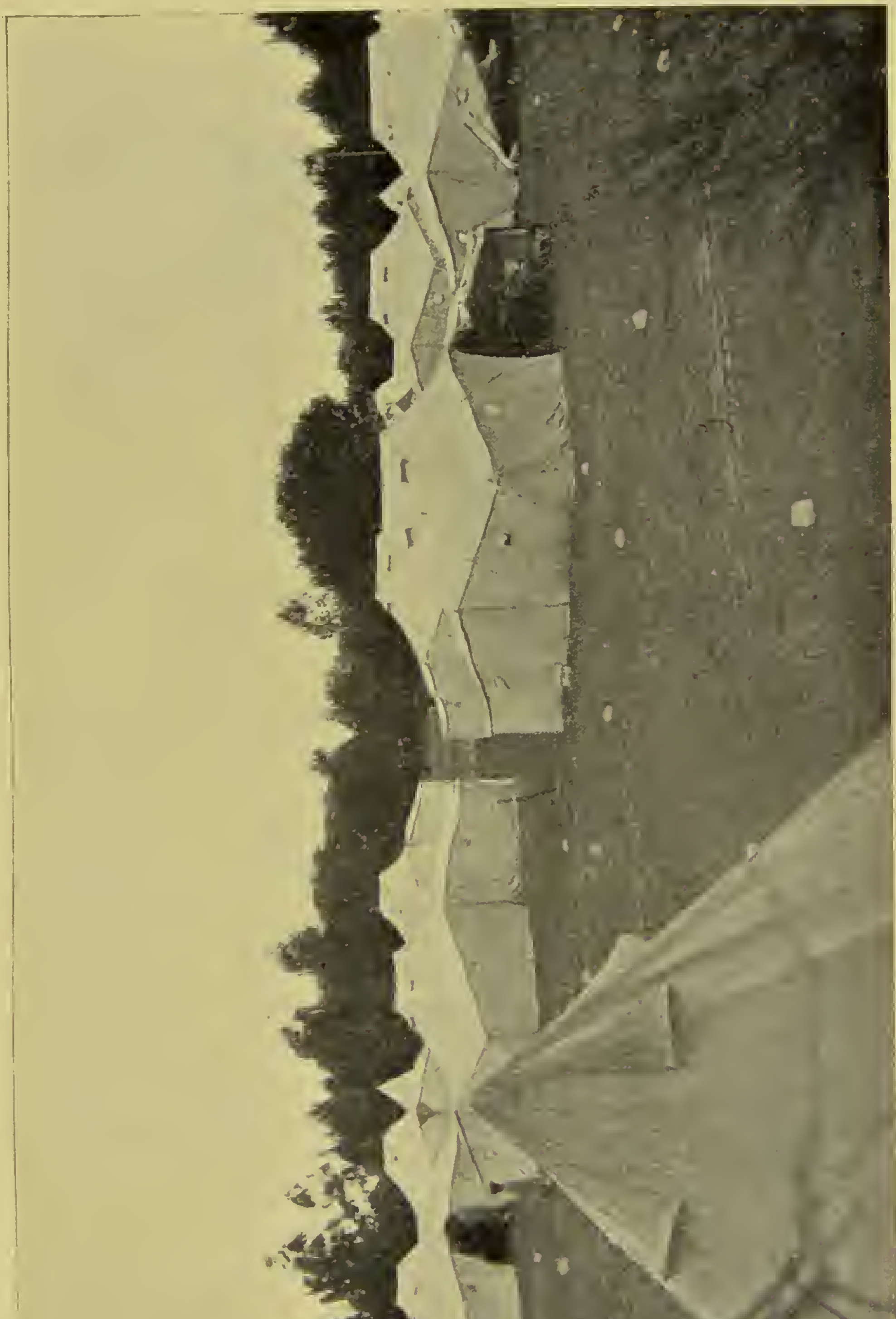
The square bell tents of the staff and orderlies were 12 feet by 9, and of single canvas. They were very commodious, but the absence of any inner lining made it quite impossible to stay in them under a hot sun, and they could not well have been used for patients. As there was no necessity for either staff or orderlies to use them during the day, the heat of these tents was not a matter of much importance. The mess tent was a square tortoise tent 20 by 20, made of green canvas with an inner lining, and was floored with cocoa-nut matting. None of the tents for patients were floored at all, and no inconvenience arose therefrom, but the floor of the operation tent was boarded, so that it might be kept free from dust and give an even surface for the operation table.

Whilst at Rondebosch we utilised the packstore of No. 3 Hospital for the storage of men's kits and rifles, whilst another storehouse was built for us by the Royal Engineers for the keeping of our stock of clothes and food, and a tortoise tent was utilised for the stores in daily use.

Our kitchen was built in a few days of wood and galvanised iron, and was fitted with a range, but we also utilised Congo-stoves. A galvanised iron wash-house for the orderlies was erected on one flank of the camping ground.

We had taken out with us ten ambulance waggons, and soon found that they were of more use to the military authorities than to ourselves. The patients who came to us were brought by train to Rondebosch Station, and

PLATE VI.



Hospital Tents at Rondebosch.

[*To face page* 24.

were thence brought to us in army ambulances, in private carriages lent by people in the neighbourhood, and in our own ambulances, but the army supplied all the animals, and there was no need for us to obtain mules of our own. Our own waggons were often used, but we need not have had them.

For the purpose of bringing parcels from the station or goods from the docks at Cape Town, etc., we purchased four mules and used them in an ambulance waggon, and the mules and various horses for private use were stabled under some trees just outside our camp. Before we left for Bloemfontein we sold eight out of our ten waggons, two of them being purchased for the use of the Commander-in-Chief.

The three months of January, February, and March, during which the hospital was pitched at Rondebosch, were hot months, corresponding roughly to our summer months of July, August, and September. They were dry months, with a hot sun and a brisk wind. The sky was generally cloudless, and the shade temperature was often about 90°. The prevailing wind was from the south-east, and was sometimes very high, but, although more than a score of the marquees in No. 3 General Hospital were split and torn during our stay, none of our tortoise tents suffered in any way, although on many days the force of the wind was very great.

The soil was light and sandy and did not easily hold tent pegs, so that we had to obtain some iron pegs two feet in length to hold the chief stays of each tent. These precautions were sufficient, and no tent was ever blown over.

It will easily be gathered from the foregoing brief description of our camp and its surroundings that we had good reason to be satisfied with the start we had made, but there was another very fortunate circumstance to notice, namely: our proximity to the three large Base Hospitals already established, and the opportunities

we were afforded of becoming at once familiarised with bullet wounds of every variety, for the battles of Modder River and Magersfontein had not long since been fought, and the wounded had nearly all been sent down when we arrived. The close companionship of No. 3 General Hospital at Rondebosch, and the courtesy of its officers, supplied us with the opportunity of visiting their 500 beds as often as we pleased, and we soon found ourselves seeing cases in consultation and inviting our friends in turn to see anything of interest we had to show them, whilst the two Wynberg Hospitals were also so easily accessible that it happened we had some 1000 beds to visit when we pleased, and an unrivalled opportunity of acquiring a large experience of gunshot wounds in a very short time.

At this period there was very little sickness and no serious epidemics. A few cases of enteric began to appear in January, but it was not until the beginning of February that the epidemic of that disease began to be serious in the camp at Modder River Station.

We were well placed at Rondebosch in other ways than on suitable soil and in a good climate, for the residents of the district vied with each other in acts of kindness. The presents of food of all kinds, and notably of grapes and other fruits, were innumerable : vegetables, milk, and butter arrived daily for the use of " No. 3 " and ourselves ; cigarettes and tobacco and pipes were supplied in abundance. Concerts were got up for the evenings, and on many moonlight and starlight nights several hundred patients and orderlies collected in an open space amidst the trees near the hospital ; and the piano, presided over by the justly popular chaplain, and the banjo of one of the Rondebosch residents, accompanied songs which were all the more appreciated if there was a chorus which was generally known. It was a picturesque sight on such occasions. The stage was lit by a couple of lamps, and the men in their blue hospital uniforms, the army nurses in their scarlet capes, gave the necessary colour to the scene. Some of the

patients proved valuable allies, and one of "Rimington's Tigers" with a tenor voice, and an Irishman who sang bass, were in constant request. We had also many lady performers, and especially one of very exceptional talents.

A little farther afield we found another valuable ally, for the owner of the steam yacht *Rhouma*, of 800 tons, offered to take twenty men and six officers as convalescents. It need scarcely be said that the offer was promptly accepted, and in a very brief space a large deck-house was built as a ward, and was furnished with bedsteads and bedding, and fresh and salt water tanks and baths, by the very generous donor. It was curious to notice how shy the first few patients were of accepting the offer to convalesce on the yacht. Reminiscences of a not too pleasant passage out, and a dread of sea-sickness, acted as strong deterrents; but as soon as the reports of the first convalescents reached the camp there was no more hesitation, and to go on board the yacht for a week or two was the ambition of most of our patients. They thoroughly enjoyed themselves there, and the soldiers and yacht's crew spun yarns in the forecastle to their mutual satisfaction, or fished with a line over the ship's side, or played deck quoits, and never found the day too long. There are many of our soldiers to whom the yacht and the life thereon must long remain as one of their most pleasant recollections. It was of great service to the Portland Hospital, and was very much appreciated by the staff.

Our female Nursing Staff consisted of four sisters, and to each of them the charge of certain tents was given. Those orderlies to whom were allotted the duties of nursing were similarly told off to be under certain sisters, and thus, before we had been at work more than two or three weeks, we had selected the men most suited for ward work as well as those whose duties were in the store, the stables, or other out-door employment. The orderlies were daily instructed in their duties by the sisters, and they very soon proved themselves apt pupils, and many of them became admirable

nurses. This was of course mainly the result of the example and precept of the sisters themselves, of whose excellence it is quite impossible to speak too highly. At Rondebosch itself their work was never very arduous, though they had plenty to do, but later on, at Bloemfontein, they were constantly overworked for many weeks, and it was only because they had trained their orderlies so well when times were more easy that the nursing of the hospital was able to sustain the strain thrown upon it, and it may truly be said that in this respect it could challenge comparison with any other hospital in South Africa.

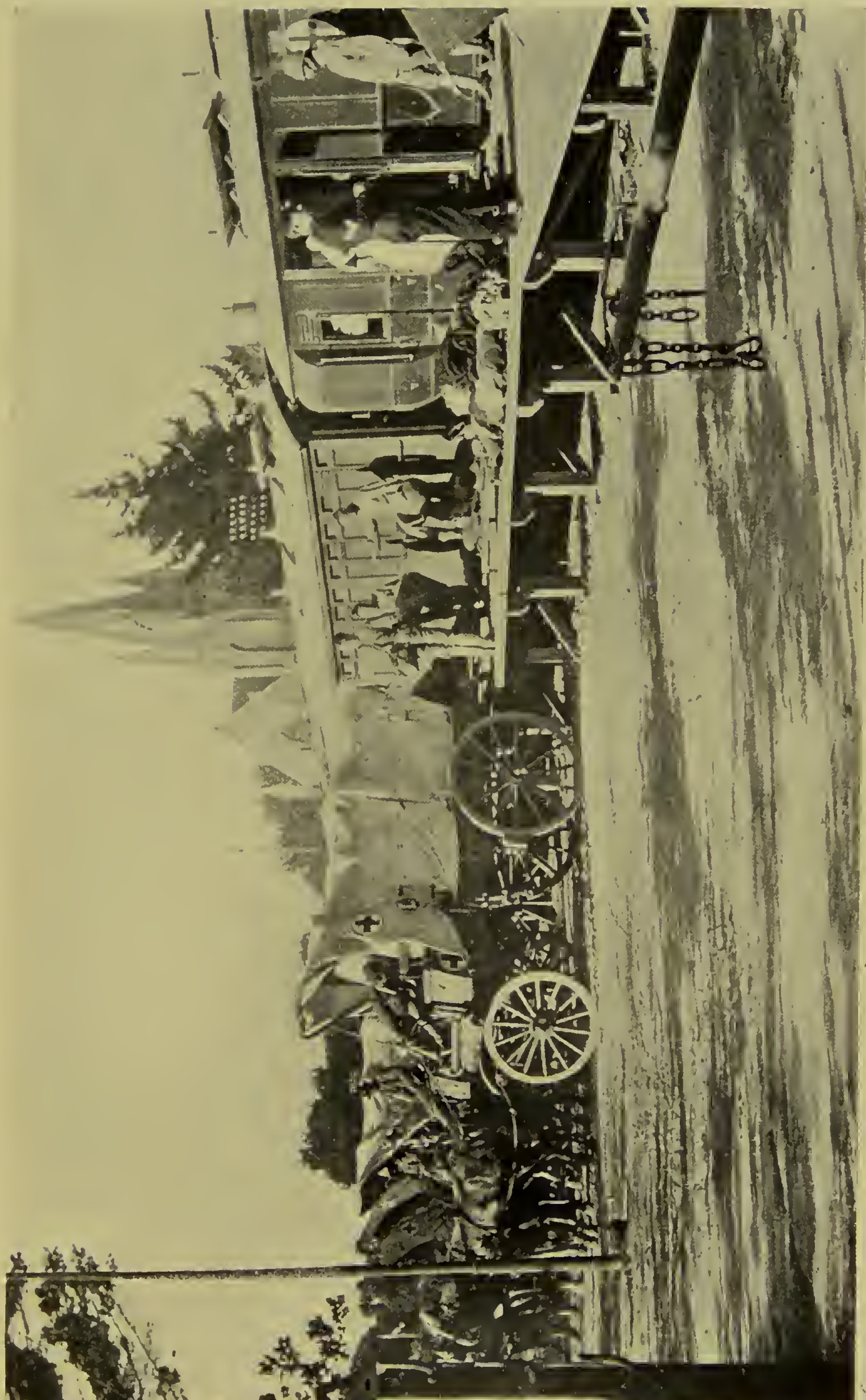
The smallness of our staff did not permit of a regular night nurse, so, as it was evidently advisable to superintend the work of the orderlies who were not sufficiently experienced to rely on their own judgment, the five members of the Medical Staff and the four nurses were all placed on a night roster and took their turn at night duty—a system which worked quite satisfactorily.

The ladies who were living in camp relieved us of all housekeeping difficulties, and took charge of the officers' mess.

They also superintended the distribution to the men of the many presents of clothing, papers, tobacco, etc., with which we had been so well provided before leaving England, and, visiting daily in the tents, they were always welcome guests, and earned the gratitude of many anxious women in England by writing home letters for men who were unable to do so themselves.

During the first part of our stay at Rondebosch our patients were chiefly derived from the troops under General French, in the country between Naauwpoort and Norval's Pont, where there was incessant fighting on a small scale constantly going on. The men were Royal Artillerymen and cavalry soldiers for the most part, but we had ere long a considerable number of infantry and of Colonial troops in addition, and then, as the fighting became more general, our patients were drawn from all

PLATE VII.



Hospital Train Discharging Sick and Wounded. Army Ambulance Waggons in foreground.

[*To face page* 28.

parts of South Africa, including men who had been sent round from Natal after the fighting at Spion Kop and Vaal Krantz.

Early in February, when the enteric fever epidemic was developing into a serious outbreak at Modder River Station, one of us (Dr Tooth) was sent to investigate the conditions of the outbreak, and, on his return a fortnight later, another of us (Mr Bowlby) visited the same place and Kimberley at the time when the wounded were arriving in large numbers from the fighting at Paardeberg and on the march thither. During the latter half of March we had very little work, for two reasons: In the first place another large hospital, No. 6 General, had been established at Naauwpoort, nearer to the front than we were; and secondly, after the blowing up of the Orange River bridges it was impossible to send sick and wounded down from Bloemfontein, which was by this time occupied by our troops.

It was therefore with much pleasure that we received orders to prepare for a journey to Bloemfontein, and on 8th April an advance party started to choose a camping ground and to make preparations, and on the 14th the hospital arrived at Bloemfontein.

Our move from Rondebosch perhaps deserves a brief description, for there are one or two matters which require a passing comment.

We ceased admitting patients and began to pack up ten days before we actually moved, but we did not evacuate our last patients till four days before removal. We took with us the whole of our possessions, and it was well we did so, for it was almost impossible to get anything sent up to Bloemfontein for weeks afterwards, and our supply of "medical comforts" was of the utmost service after our arrival, at a time when it was very difficult for the supply to keep pace with the constantly and rapidly increasing demand. We packed our stores mostly in the boxes and cases in which they had been

sent from England, and we obtained the help of two packers from Cape Town to assist in dealing with the glass and china. The beds and mattresses were roped together and packed in cases of six each, and the blankets were separately packed. The large tortoise tents were divisible into four equal parts of about 80 lbs. each, and were easy to handle thus divided, while the small bell tents of the staff presented no difficulties.

Our whole kit was finally packed in the large trucks called "trailers," which were dragged by one of the military traction engines, and were taken by the latter to the siding at Rondebosch Station. The only misfortune that occurred at this time was that the traction engine when on its way up to our camp broke through a wooden bridge and carried it, together with the whole width of the roadway, into the bed of a stream. It was two days before the road was repaired and the engine put on its wheels again, but the delay was of no importance as we had yet time to get packed before the date fixed for our departure. Our train, consisting of eleven trucks, was drawn up at the siding, and our own orderlies loaded it up in a day.

It left Cape Town on 8th April and arrived at Bloemfontein, after an uneventful journey, in six days' time.

During our stay at Rondebosch of just three months, we had had altogether 477 patients. Of these but one wounded man died, namely, an officer who had been shot through the chest and spine and was almost completely paralysed. All our other wounded did exceedingly well, and, though some of them had been badly hit, they were all fortunate enough to keep their arms and legs. One man had his forearm and his leg shattered by expanding or so-called "explosive" bullets, and not so many years since would have probably lost both of them. He did very well, however, and was on a fair way to recovery when he went to England.

PLATE VIII.

GENERAL VIEW OF BLOEMFONTEIN LOOKING SOUTH.

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When we arrived at Bloemfontein we found that the Irish Hospital had also just arrived from Naauwpoort and was pitching its tents, and that the Langman Hospital was being erected in the cricket ground. The staff of No. 8 Hospital and most of its kit had arrived, and the tents of No. 9 were also in process of erection, but neither of these hospitals was ready for work.

The principal medical officer, Col. Stevenson, informed us that we could either camp below "Gun Hill," near to No. 9, or could go to the south-west of Bloemfontein about a mile and a quarter from the town, and after a walk over the whole of the ground around the town, we decided in favour of the latter site and never had cause to regret it.

For some time before we arrived there had been great difficulty in obtaining a supply of water, for owing to the loss of the water works Bloemfontein was dependent entirely upon the spring from which the town takes its name—"the Bloemfontein"—and upon wells and dams. These gave a wholly insufficient supply of doubtfully pure quality, and, in addition, every drop of water for all the troops and for the numerous buildings utilised as hospitals had to be pumped into water carts and taken very considerable distances by road. Fortunately, a few days before our arrival the Royal Engineers had re-opened two wells at the depth of 140 feet and 160 feet respectively, to the south-west of the town, and, after sampling the water, we at once decided to camp near it, for it was impossible to over-estimate the value of good water, and the ground near to the wells was fresh and clean, not having been previously occupied by any troops. It thus came to pass that the Portland Hospital was ere long erected in "The Park," for that was the name given to the open veldt on that side of the town.

Our stores were detrained on the morning of 14th April, and were some of them sent up to our camping ground by a traction engine that day. Most of them, however, did not arrive till after nightfall on a dark and

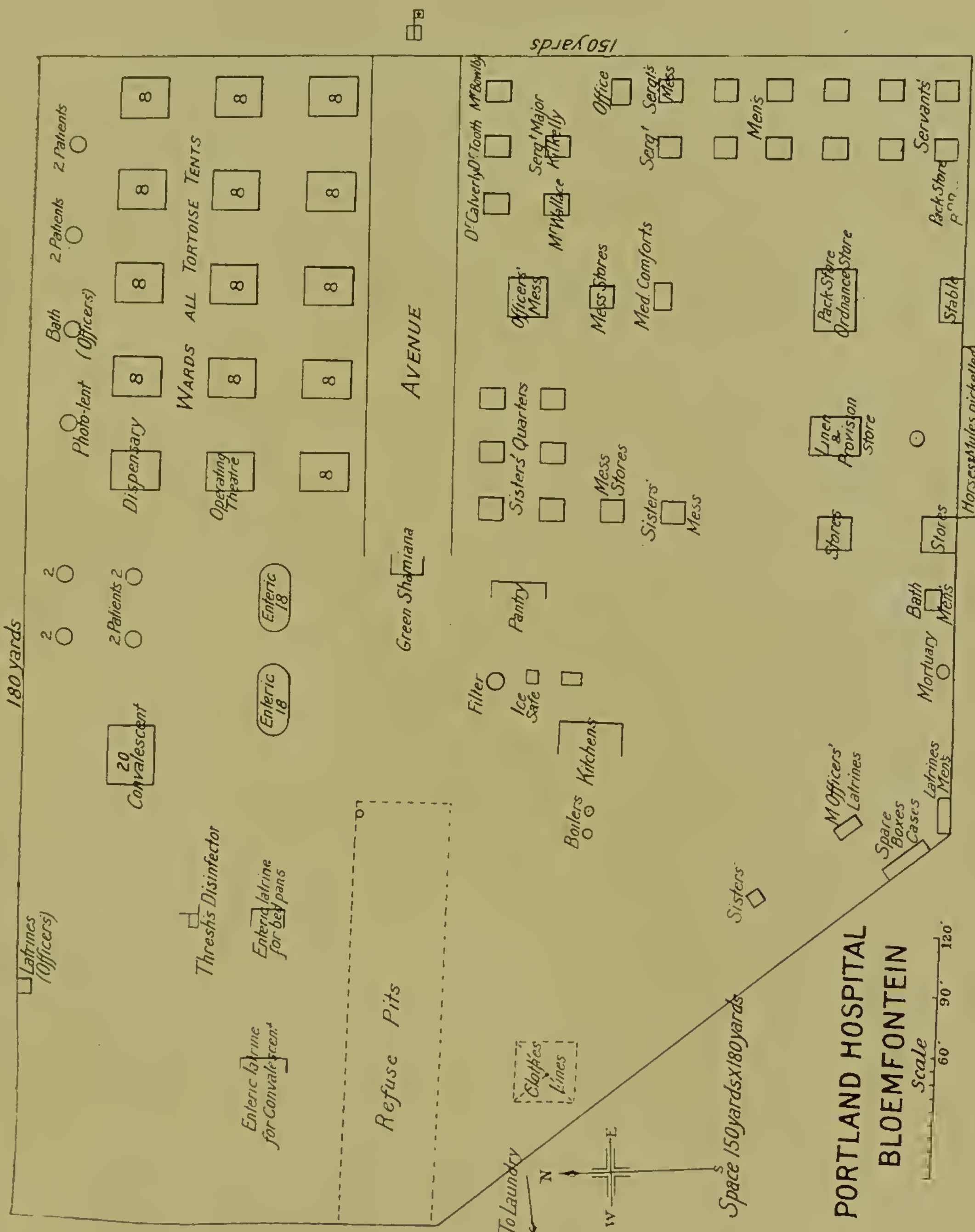
wet night, and it was late before we had off-loaded the sixteen ox-waggons which carried our equipment. Next day—Easter Sunday—we had a busy time, pitching tents and unpacking a few things, but the afternoon brought with it a tremendous thunderstorm and a perfect deluge of rain, and made a horrible mess of much of our ground. We had already dug trenches round our tents, but the next day we had to dig long drains to carry off the water that trickled down the hillside, and which would have flooded us had we not been on sloping ground where it quickly flowed off.

We had a good deal of wet the next few days, but there were fine intervals, and when the sun came out things dried very quickly, so that we were able to go on pitching camp and unpacking stores, and although we were a good deal delayed by the wet, we were yet able to take in over 40 patients on 21st April.

The rain that had fallen had certainly impeded us, and had soaked the camps of the troops, who had all too few tents and shelters, but it had its advantages, for it filled up the dam at the entrance to the town and replenished all the springs and wells, so that there was a better supply of water. It had also a more far-reaching effect, for, by providing an abundant supply of water in the dams and vleis throughout the Free State, it greatly facilitated the march of our armies in their advance north.

Our new site was on the slope of a hill. The ground was covered with a thick crop of short grass, and the soil was light, though it soon became muddy and sticky when there was rain, and did not easily soak up water. Near to the camp, and between it and the town, was a cluster of willow trees, which were all the more noticeable because of the bareness of the surrounding country, and past them a road or track ran to the south side of the town.

Our camp faced nearly due north, and looked on to the hills on the slope of which the recent parts of Bloemfontein are built. On the flatter ground below, where the hills



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rise from the veldt, were the tents of the 6th Division, and a little further and to the left was the camp of the Cavalry Division. Further on the right lay the tower of the Government buildings, and still more to the east was the President's house, lately the residence of President Steyn. In this direction also the turreted mountain top of Thaba N'chu rose, and looked only some fifteen or twenty miles away, though really it was more than forty.

To the south-east of our site, about a mile and a half away, lay the tents of the Highland Brigade and of the Artillery Camp, together with the encampment of a regiment of Colonial Horse; and in our rear, towards the south, was the open veld stretching away to Leeuw-Berg and Brandtkop and the trees of Holden's farm. To the west and close to us was the camping ground of No. 8 General Hospital, and over the hill, up which their tents reached, lay an artillery camp near to the Kimberley Road.

We were indeed very well placed, being in open country and surrounded by the various divisions, yet at the same time having a clean and healthy camping ground placed not too far from the town.

The general health of our troops at Bloemfontein was at this time certainly bad, and very large numbers of men were daily going sick with enteric fever, whilst almost every one suffered, more or less, from diarrhœa, and there was a good deal of dysentery. For the explanation of this we must go back a little.

Before our army left Modder River Camp there had been an increasing amount of enteric fever, and not only were many cases left behind, but it is practically certain that many men already infected marched out with the army and did not develop the disease for perhaps a week or a fortnight. It is very probable that the Modder River water below Paardeberg was infected by the Boer force, for there was certainly a good deal of enteric fever

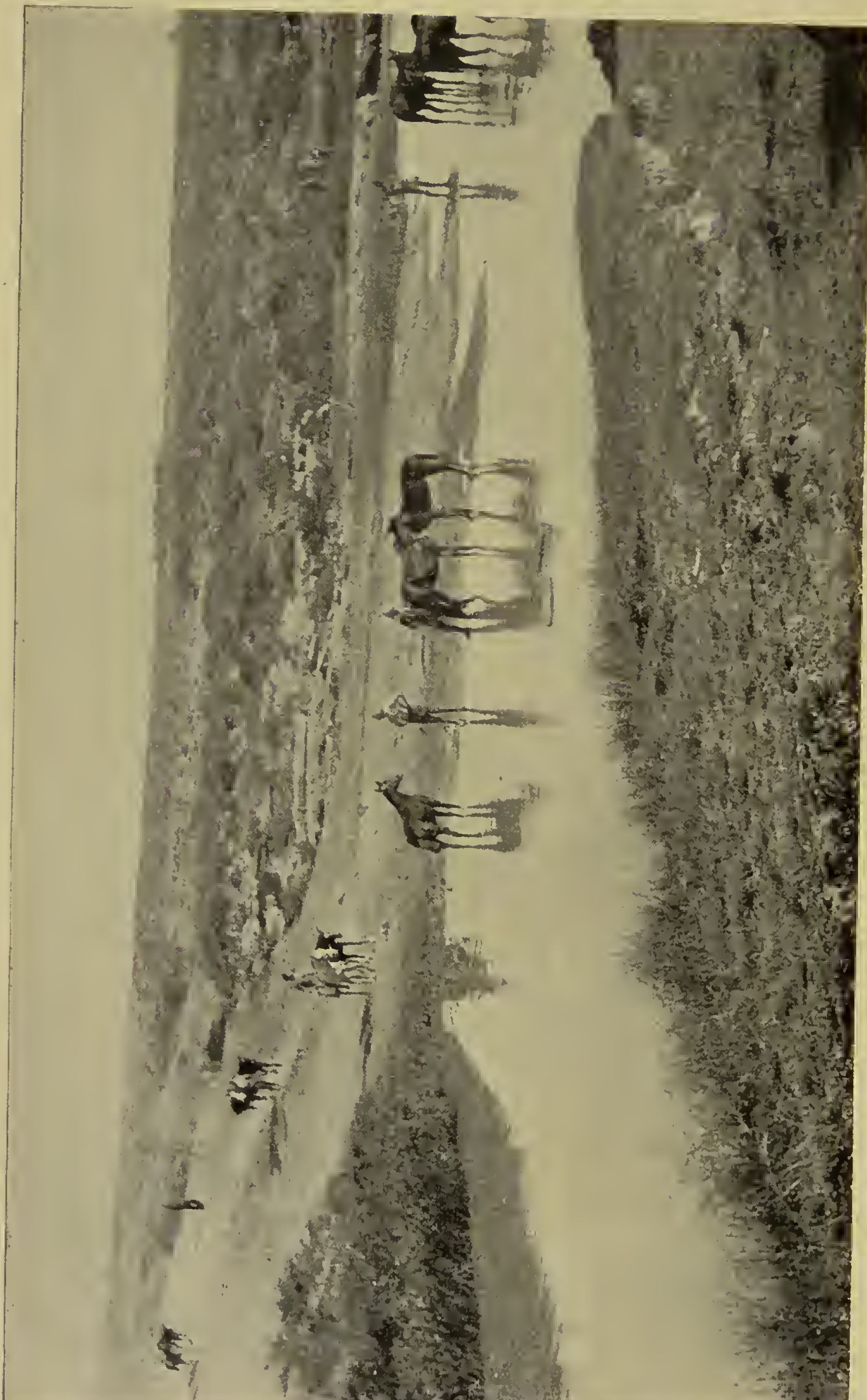
amongst the Boers whom we captured there, and no doubt more of our men became infected near Paardeberg, so that when we arrived in Bloemfontein we took with us into that place both men already suffering from enteric fever, as well as others who were to develop it within the next few days. There is of course no doubt that many of the sick men infected others, for they often remained in the ranks until the disease was well advanced, and where men are feeding together and using the same utensils, there are abundant opportunities of contagion.

In the next place, and apart altogether from enteric fever, the men had had a very trying time, with long marches and short rations, and both great heat and much wet to make matters worse. When our army reached Bloemfontein the clothes of many of the men were worn to rags, and their boots were in shreds, while the destruction of the Orange River bridges and the injury to the railway line prevented any tents from arriving for some time, and left the men camped on a wet and muddy soil, on which many of them had to lie at night in their wet clothing. It is easy to understand how diarrhœa and dysentery increased under these conditions, for some time elapsed before the repair of the bridges and the restoration of the railway line allowed of the transport to the front of the tents and stores, which were in such abundance only the other side of the Orange River.

Under these circumstances the Field Hospitals quickly became crowded, and as fast as the various Civilian and Army Hospitals opened their beds they were filled with patients. A large proportion of the latter were sick, but we also had many wounded sent to us from the fighting which took place towards De Wet's Dorp and Thaba N'chu.

On 21st April we took in 42 cases from one of the Field Hospitals, and a few days later one of us (Mr Bowlby) went, together with Mr Makins, to the camp of the 9th Division near the water-works, to see some badly

PLATE X.



THE DRIFT ON THE MODDER AT SANNA'S POST.

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wounded men. "Sanna's Post," where the water supply is taken from the Modder River, is about 24 miles from Bloemfontein, and had been recaptured by our troops on the 22nd, after which there had been more fighting on the way to Thaba N'chu. We had had a good many men wounded, and the officers of "Marshall's Horse" had suffered most severely. One of them was dead, and the officer in command and three others were more or less severely wounded. One of them was well enough to travel, so he, with several waggon loads of other sick and wounded men, was sent off to the Portland Hospital in the evening, and a few days later the remaining two officers and a private, who as it proved was fatally injured, followed them. It was on this occasion that we first made the acquaintance of the Indian Tongas presented to the army by Mr Dhanjibhoy, and especially built for the rapid conveyance of the wounded. They proved very comfortable ambulances, and were of much service, though they were too small to take comfortably more than two badly hit men. Their springs, however, were very good, and they took patients with much less shaking than any other form of vehicle.

The ox-waggons, especially those that had springs, were both capacious and comfortable on good roads, and, where patients who had to lie down could be supplied with plenty of hay, straw, or grass for bedding, there was little to complain of. There was, however, much, though unavoidable, suffering caused to men with broken bones in places where the road was stony and rocky, and especially where the track crossed a spruit or watercourse with steep banks and a rocky bed. At such places even a carriage with perfect springs would have jolted and bumped, for none of the roads are macadamised, and no attempt is made to move away even the most obvious loose rocks and stones that are so freely littered in many places.

With all the ox-transport it is the custom to make

night journeys, for thus the oxen both feed better by day and do their work at night when the weather is cooler, and thus it happened that convoys very frequently arrived at hospital at night-time and in the early hours of the morning.

On 29th April we took in another convoy of 30 men and officers, most of whom belonged to the cavalry and had been wounded some thirty miles away: there were also a few sick.

The convoy included six Boers, five of whom were more or less severely wounded. They were all Free Staters and well-built, healthy-looking men. Three days later some more wounded men and a Boer lad of 22 shot in the thigh arrived late at night, and all the time more cases of sickness, amongst which were many patients with enteric fever, continued to arrive from the camps around us. Our hundred beds had become all too few, and, as accommodation for officers was everywhere difficult to provide, considering the large number going sick, we increased our beds to 130 for non-commissioned officers and men, and 30 for officers. In order to do this we had to obtain two large ordnance store tents, which we utilised for enteric patients, and to fit up a tortoise tent with stretcher-beds and straw for more convalescent cases. The ordnance tents proved excellent—they were 60 feet in length and 30 feet in breadth, and were airy and high, and, though never intended for patients, they made excellent wards for 18 beds each. They were pitched in the rear of the camp so as to be as much isolated as possible, and the only drawback to them was that they were made of single canvas; this made them rather cold at night, and although the weather was no longer hot, the sun was sometimes too warm for a single layer of canvas in the day-time.

On 4th May one of us (Mr Wallace) went, together with Mr Makins, to join the 9th Division at Brandford and Winburg, in the general advance to Pretoria, remaining with one of the Field Hospitals for the next fortnight,

PLATE XI.

AN INDIAN TONGA.

[To face page 36.

and then returning with a large convoy of sick and wounded.

All the month of May sickness was rife, and enteric fever spread with increasing rapidity both at Bloemfontein and amongst the troops marching north. The weather from 18th April had been very fine and bracing, with brilliant, sunny days, and clear, cool nights. Ever since our arrival we had been troubled with myriads of flies, and as the country became drier, there was also a great deal of dust. The flies, it appeared, had come with the army, and we were assured by residents that in other years there had never been many flies at any time. We thought ourselves that they were very harmful in conveying disease, and knowing how they swarmed over the worst cases of enteric fever, we viewed their presence on every article of food with much distrust. Considering also the very soiled condition of the ground near to the various large camps, we felt that there was much danger in the dust which was sometimes very bad nearer the town, and in its streets. It should, however, be noted that typhoid fever never assumed a serious aspect amongst the civilian population, even when at its worst amongst the troops in camp.

There can be no reasonable doubt that many camps became regularly contaminated, and in the case of the 6th Division an immediate improvement in the health of the troops resulted when the General in command, at the instigation of the Principal Medical Officer, changed the camping ground of every regiment. All of them were moved at least a couple of miles away, and one regiment was camped out at the water-works 24 miles distant.

In certain camps an immense proportion of the men and officers went sick with enteric, in spite of every precaution being taken to boil or otherwise purify the drinking water, and we thought that if all the camps could have been shifted after the bulk of the army marched for Pretoria, it would have been a very good thing from a sanitary point of view.

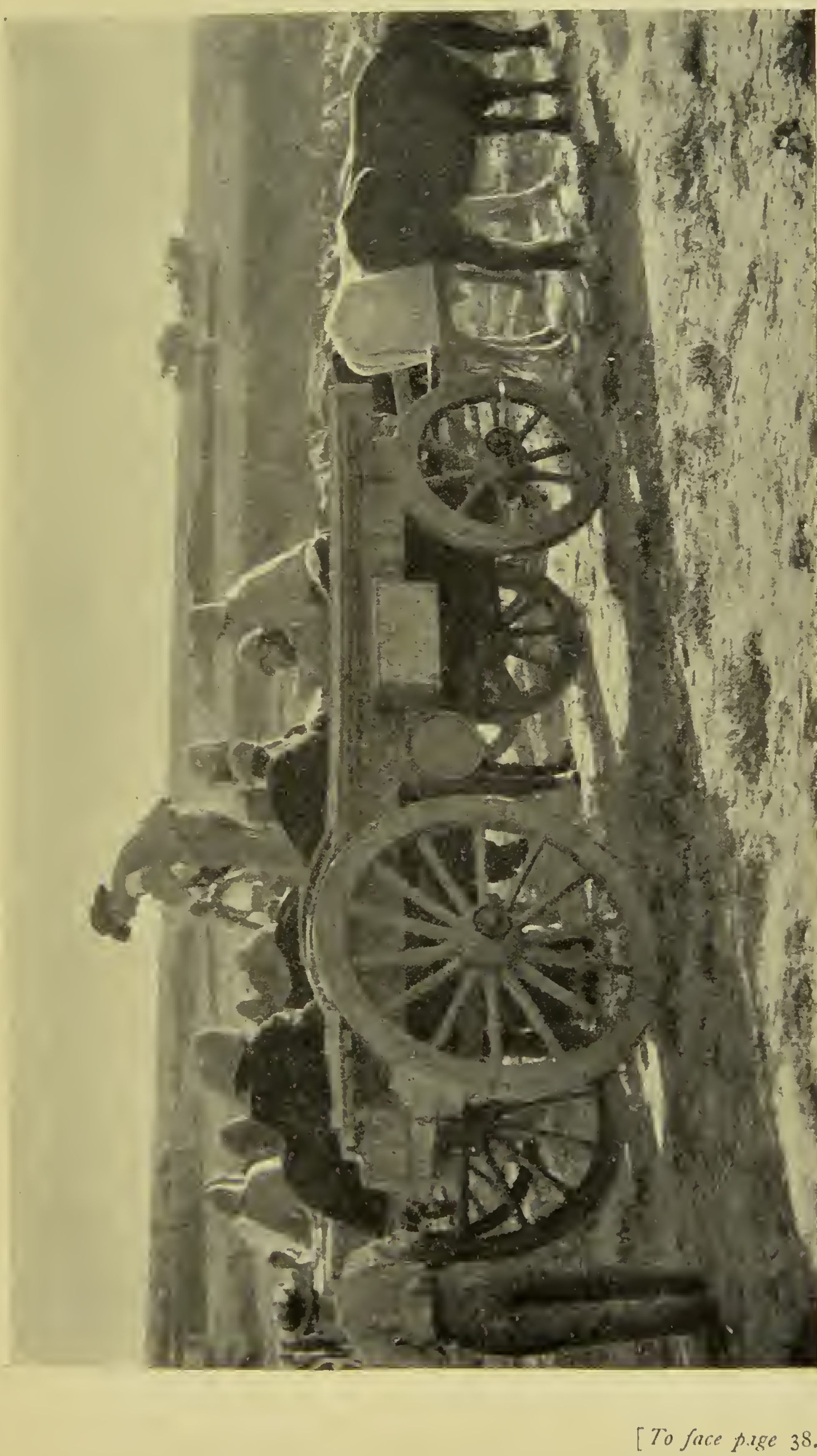
It is perhaps even now hardly realised how large a number of our troops went sick in a very short time. We were told by the medical authorities that on 4th May, when the army was *en route* to the Transvaal, there were 4500 sick and wounded left at Bloemfontein, and that by 28th May the number of men unfit for duty had been increased to 11,000. No wonder that it was difficult to provide accommodation and hospital equipments sufficient to keep pace with so rapidly rising a tide.

The difficulties indeed were liable to be increased in another way, for not only was it difficult to supply fresh orderlies in proportion to the increasing number of patients, but a very large number of orderlies, of servants of sick officers, and of soldiers detailed for hospital work, contracted enteric fever from attendance on the sick.

The reality of the risk run by the orderlies may be gathered from the fact that nine out of our twenty-four men were attacked, and of these one died. One of our sisters was also infected, but made a good recovery. In the face of these risks the behaviour of our orderlies was beyond all praise. They were all St John's Ambulance men, and had had no previous experience of hospitals or sick people. They proved a most excellent lot, and were most keen to learn to nurse.

It was quite surprising to us to see how little they seemed to fear being attacked, though they could not help knowing that the risks were very considerable; and this was all the more noticeable, of course, because they were not used, like ourselves and the sisters, to see sickness and death; at the same time it was all the more creditable. The conduct of the men was indeed most praiseworthy. They came out to nurse for six months, and at the expiration of that time, with one exception, they all stayed on when it was found that their services were needed for a longer period. They seemed to think that they were bound to see it through, and they proved willing and helpful till the end of our stay.

PLATE XII.



AN OX-WAGGON WITH WOUNDED AT SANNA'S POST.

[*To face page* 38.

It is impossible to speak of the troops at Bloemfontein and of their sufferings without alluding to the work of the Red Cross Society. Down at Rondebosch we were ourselves nearly quite independent of it, but up at the front things were different, and, owing to special trucks being placed at the Society's disposal for transport of goods from the base, it was enabled to obtain supplies of food and clothing and hospital appliances which were much needed by all. We owed a large debt of gratitude to Colonel Ryerson, the Canadian Commissioner, who was in charge of the British Red Cross stores, for much assistance when it was most needed, and when we were called upon to enlarge our hospital we obtained from him invaluable supplies of kit, and, at a time when it was difficult to get much milk and "medical comforts," we drew from the Red Cross depôts supplies of all kinds, which we could not then obtain elsewhere. The Society seemed at all times to have just what was most wanted, and its stores seemed inexhaustible, though it was not always easy to get them to where they were most required.

The month of June found us still busy, but the closing days of May had brought with them some keen, frosty nights, cold enough to cover our water buckets with ice, and cold enough, as we soon found, to kill most of the flies. The townspeople had always been very positive as to the departure of the enteric fever when the cold nights set in, and we had been told by many people that the previous epidemics had always ceased after the winter frosts. It was at any rate certain that the decrease of the fever was coincident with the fall in temperature, and by the middle of June there was a very rapid decline of the epidemic. It ceased almost as suddenly as it had begun, and by the beginning of July there were very few fresh cases.

It has already been mentioned that we admitted several convoys of wounded from the fighting east and south of Bloemfontein, and then, during the few weeks that were occupied in the advance of the army to Pretoria,

wounded as well as sick men came in from the various skirmishes. Consequently, as the hospitals were very much crowded, Lady Roberts arranged for the conversion of the ball-room at the Residency into a ward for wounded, and fitted it up with 36 beds. It was under the charge of Major MacMunn, and one of us (Mr Bowlby) was asked to act as consulting surgeon to it. The extra beds came in very useful at a time of great pressure, and the room made a most excellent ward, and was much appreciated. At this time also the various consulting surgeons were either with the advancing army, or else had returned to England, and it therefore happened that, owing to the courtesy of the staffs of most of the other hospitals, we saw many of the most serious cases in consultation, whilst the services of one of us (Dr Tooth) were similarly requisitioned in cases of enteric and dysentery.

As at Rondebosch, so also at Bloemfontein, many of the officers of the R.A.M.C. and the civilian surgeons attached to the military hospitals did everything in their power to enable us to see all that there was to see of military surgery and medicine, and we in turn were glad at all times to offer them whatever hospitality the Portland Hospital could afford.

With the month of July came empty beds and empty tents, and it seemed difficult to believe that the whole of the sickness and over-crowding should have come and gone in three short months. Yet such was the case, and it thus happened that we found ourselves with nothing to do at Bloemfontein but look after convalescents, so we placed ourselves in communication with the military authorities in order to ascertain what might be required of us, informing them that we were prepared to stay until September if our services were required, but that three of the existing staff would be obliged to return to England in October. We heard in reply that it had been decided not to send any more hospitals to the Transvaal, and that there was no present need for the maintenance of so many beds

as had hitherto been required, so, as the time for which the Portland Hospital had been authorised had already expired, and the contracts with our orderlies and sisters were running out in August, we reluctantly were forced to the conclusion that we must bring our work to an end.

At the end of July, therefore, we arranged to sell all our kit and remaining stores. The Ordnance Department bought our tents, and there was keen competition between the officers in neighbouring camps and the townspeople for the purchase of blankets, linen, and eatables of various kinds. We also found ready purchasers for drugs and surgical dressings, and if our stores had been in much greater quantities than they actually were, we should have had no difficulty in selling them all, for Bloemfontein had been practically cleared out by the Boers, and the difficulty of getting up fresh supplies by the over-worked railways had left every one for miles around very short of all kinds of household goods.

It thus happened that two of the staff (Dr Tooth and Mr Calverley), together with the nurses and orderlies, took charge of the hospital and invalid officers on board the transport *Canada*, whilst Surgeon-Colonel Kilkelly was appointed to the post of Principal Medical Officer to the Yeomanry Branch Hospital at Pretoria, and Mr Bowlby went to Natal and visited many of the hospitals in that Colony.

The work done by the Portland Hospital during its stay from December to July may be very briefly summarised. It admitted 1009 officers and men, and of these, 37 died, 159 returned to duty, 303 were discharged to convalescent camps or hospitals, 98 went to England, and 412 were transferred to other hospitals at the base.

The general results obtained in the treatment of the wounded were very satisfactory. Altogether we admitted into the Portland Hospital 303 surgical cases, and of these only three died: one of them was an officer who had been shot through the lung and spinal cord, and was paralysed

from the neck downwards; another was a man shot through the brain, who survived the injury nearly a week; and the third was a man with gangrene of his leg, who died from gangrene of the other leg, due to formation of a clot in the abdominal aorta, a week after one limb had been amputated.

All the other patients recovered, and in none of them was it found necessary to amputate either upper or lower extremities, though in some cases the saving of the limb was not at all an easy matter. · The fact that our patients were practically all treated in the open air, and that our tents were never crowded, no doubt had much to do with the fact that nearly all the wounds healed without suppuration, and that there were no cases of erysipelas or other forms of septic poisoning.

Statistics of Surgical Cases.

Gunshot Wounds :—	
Spine and Back	7
Abdomen	12
Head and Neck	24
Thorax	10
Joints	18
Lower Extremity	82
Upper Extremity	57
Various Injuries, including Fractures	36
Surgical Diseases	57
Total	303

NOTES ON THE EQUIPMENT AND PERSONNEL OF CIVILIAN WAR HOSPITALS.

CHAPTER III

NOTES ON THE EQUIPMENT AND PERSONNEL OF CIVILIAN WAR HOSPITALS

It is most probable that in the event of any future war requiring the presence of large armies in the field, the services of civilian surgeons will again be called for, and it may well be that civilian hospitals equipped by private generosity may again be sent to the seat of war. It is with these possibilities in mind, therefore, that we propose to express our own opinions on some of the questions which are raised by these considerations, and we do so in the hope that our experience may be of some service to others.

In the first place, the Medical and Surgical Staff demands consideration, and we may at once express the opinion that four civilians are quite adequate for the unit of 104 beds—this being one-fifth of a General Base Hospital. It must, however, be borne in mind that a staff of this number is quite capable of undertaking the work of at least 150 beds, and that if the unit were increased to 208 beds, such a hospital would not require more than six surgeons and physicians. A hospital of 416 beds would be adequately worked by a staff of twelve, and one of 520 by a staff of sixteen, always on the supposition that a R.A.M.C. officer (or officers) is attached for purposes of commissariat, transport, and administration of details required by the Army Regulations.

In the selection of a staff of four, it is certainly desirable to obtain the services of men who can adapt themselves to varieties of work, as it is evident that specialists cannot be provided for. The staff of the Portland Hospital was selected with these considerations in view, and one member of it undertook, in addition to his medical work, the duties of anæsthetist and charge of the X-ray department, as he had a good knowledge of photography; whilst another member took charge of all dental cases, of which he had had some special experience. Two of the staff had also some special knowledge of throat and ear work.

At least one of a staff of four should be an experienced physician, and one of the other three should be ready to take charge of medical cases or to assist in the surgical work as may be required.

It is the experience of all wars that there are more deaths from sickness than from bullet wounds, but whilst this necessitates the presence of a physician on the staff of four, at least two surgeons should be taken, so that in case of surgical emergencies and large numbers of wounded there may be two men able to work separately, and each provided with an assistant, for in this way the best use can be made of so small a staff.

With work thus distributed there is also opportunity for the temporary absence on other duty of one of the surgical or medical side, or for the carrying on of the work in the event of illness of any individual.

When the hospital is larger, *e.g.*, 416 or 520, and has a staff of twelve or more, it should be provided with a senior surgeon and a senior physician in charge of the respective surgical and medical sides, and should have at least one other physician and surgeon of consultant rank, the other members of the staff being chosen so as to ensure that there are amongst them men with special knowledge of radiography, anæsthetics, eye work, and dentistry. But it is seldom worth while, except perhaps for X-ray work, to

take a man for any one of these alone, and each man should be ready and able to give his help in the regular routine work of the hospital wards.

Exception may also be made with regard to a trained pathologist, whose services would always be of the greatest value in the investigation of disease, with the object of its better treatment in future campaigns.

It is absolutely necessary that all hospitals at the seat of war should have one R.A.M.C. officer at least in charge of the office work, the orderlies, the transport, and the commissariat; and in any large hospital he should be assisted by a competent quartermaster to take charge of the pack store and the provisions, and to see to the carrying out of all details under the supervision of the officer in charge. It must be remembered that the average civilian has no knowledge of the military duties of orderlies, of pitching camp, of making latrines, or of requisitioning rations or transport. He has, in fact, none of the requisite knowledge or experience required to enable him to be of as much use as possible to others, or on the other hand to get from the various Army Departments the help that is willingly given and readily provided: *e.g.*, by the Royal Engineers in providing temporary buildings or laying water-pipes; by the Ordnance Department in supplying material of various kinds; and by the Transport Department in sending ambulances for the conveyance of wounded, etc. The R.A.M.C. officer is thus the necessary link between the civilian surgeon and the army with which he works, and although a good deal of the army routine can quickly be picked up, there is much that cannot be learnt in a short time.

The number of nurses required for a Base Hospital is rather difficult to decide, but the number (four) to which we were limited by the military authorities was barely sufficient. Five seemed to us a reasonable number for 104 beds, and would have enabled us to have one of the sisters acting as a night superintendent. When we increased our

accommodation at Bloemfontein so as to take in 160 patients we had indeed to obtain the services of two extra sisters, for with a large number of men seriously ill from enteric fever, it was evidently unsafe to leave them all night in charge of the orderlies, who could not be expected to recognise the sudden advent of any serious complication — such as hæmorrhage — requiring the prompt attendance of a medical officer.

It seemed to us that, with a proper number of orderlies, five sisters to each 104 beds of any Base Hospital would be a satisfactory staff, so that the complement for a hospital the size of any of the large Military Base Hospitals of 520 beds would be twenty-five, although it would be well to take three or four beyond the number to allow for possible sickness.

It need scarcely be said that each one of them should be a thoroughly trained and competent nurse, capable of training and teaching the orderlies under her, and that amateur nurses, however willing and obedient, would be of no use on such a staff, for the small number of twenty-five for a hospital of 520 beds presupposes that each of them is not only in no need of supervision as a nurse, but has the knowledge requisite for teaching others.

It is also necessary to have one or more maids, according to the size of the hospital, to wait upon the nurses, for at a time of considerable pressure the latter should be entirely freed from the work of making their own beds or preparing their own food. We found one good maid sufficient for our nurses even when we increased their number to six.

The Nursing Staff should have a separate mess and mess tent, and also separate tents for the private use of each nurse. In conclusion, we think it advisable that any large hospital should be arranged with a view to being subdivided in case of necessity.

The Orderlies.

Orderlies attached to Civilian Hospitals in war will, as a rule, be practically untrained men. They should be chosen so as to have representatives of different trades and occupations, for carpenters, packers, smiths, etc., may all prove very useful acquisitions in camp.

As to numbers, the twenty-six fixed for us by the military authorities, exclusive of two R.A.M.C. sergeants, and of our servants and cooks, seemed to us sufficient for our 104 beds, and proportionate numbers would suffice for larger hospitals.

It is better to separate men who seem specially suitable for nursing from those detailed as clerks, in charge of pack store, transport, etc., and to allot certain men to certain nursing sisters, to whom they are subservient in all their ward duties and from whom they should take all orders. This is far better than the system of placing men on one long roster of service, which results in the orderlies of individual tents constantly changing, and prevents the sisters from properly training any of them. It is in every way a distinct advantage to give the sisters charge of the training of their own orderlies, for it excites a certain amount of healthy rivalry, and every nurse will naturally have her own ideas as to the exact method of performing various duties. In this way, also, it is easy to get to know the most efficient and trustworthy men, and to allot them their duties accordingly.

Night duty is necessarily a matter somewhat difficult of arrangement when there are very serious cases requiring constant care ; moreover, at a time when a hospital is full, night duty falls very heavily on those who have to work by day as well, and it is evident that with such comparatively inexperienced nurses, as all orderlies must be for some time at least, it is necessary to have very careful supervision of them at night. In our opinion there should be not less than four orderlies and a sergeant always on duty, together

with a night superintendent, for a hospital of 104 beds, and the orderlies should be allotted for duty to the tents in which they are accustomed to work by day, and in which they consequently know the patients.

We found it practically work better to arrange so that no man was ever on duty the whole of a night, for under these circumstances his health and his work by day were liable to suffer. We therefore arranged that the men for night duty should be detailed into two "shifts," one lot going on duty from 7 P.M. till 1 A.M., whilst the other lot relieved them at that hour and remained on duty till 7 A.M., at which time they in turn were relieved. We believe that this plan is a good one, and we found that it was much in favour with our men, and that it worked very satisfactorily.

TENTS.

Where the climate is suitable, tents are preferable to huts, being decidedly more healthy and more easy to keep well ventilated. In very cold and wet weather, however, it is difficult to keep the patients sufficiently warm, and there are many climates where huts or permanent buildings are preferable. Tents, however, must necessarily be provided as part of a hospital equipment, for, without them, a forward move might be impossible, and they are then always available when the weather permits of moving out of buildings.

In order that a hospital may be as mobile as possible and may consequently be utilised to the utmost, it is of great importance to have the tents as easy to pack and as light as possible, whilst at the same time their shape should be such as to accommodate a large number of patients in proportion to their weight.

1. *The Tortoise Tent.*—The tents with which we were provided measured 24 feet by 20 feet, and are divisible into four quarters, each weighing about 80 lbs., so that with ropes, pegs, and poles the weight is about 340 lbs. They

PLATE XIII.

A Tortoise Tent.

[*To face page* 50.

are oblong, with rectangular corners, and are fitted with two poles connected by a ridge pole, together with small side poles to maintain the roof at a proper elevation. They have a "door" in each side, and small ventilators in the sides and roof. They are lined with a thin layer of canvas separated from the outer canvas by an air space, and are watertight. These tents easily accommodate eight beds and ward furniture, and are not really crowded with ten beds.

2. *The European Private Tent*, commonly called the "E.P." Tent.—These tents were in use in many of the Natal Hospitals, and were in much favour. Their shape is very similar to that of the tortoise tents, but they are only 20 feet by 20 feet, *i.e.* 4 feet shorter. They consist of three layers of canvas, the middle layer being of a red colour so as to prevent penetration by the rays of the sun. They weigh about 520 lbs., and are not capable of being divided into segments. They are cool in hot weather, and also keep out the cold well. When three of them are pitched close together and their contiguous sides braced up they make an excellent long ward. They accommodate six beds easily, and with eight beds are about as full as is the tortoise tent with ten beds.

3. *The Hospital Marquee*.—These tents are very lofty, are oval in shape, and have a complete double canvas throughout, with an air space between the layers, so that they are really almost like two tents superimposed. They weigh about 520 lbs. and are not divisible into segments. Their poles are large and heavy, and they require a very large number of pegs to fix them. They measure 18 feet by 15 feet. On account of their oval ends they are not so commodious as the rectangular tortoise or "E.P." tents, and do not comfortably accommodate more than six beds.

The general opinion of most men who have had experience of these three types of tent is that the hospital marquees are the least satisfactory, and for these reasons:—They are very heavy, and their poles are very long, heavy,

and cumbersome to move. They require a considerable number of men to pitch them, and they are not easy to pitch. On account of their shape and the attachment of the guy ropes, great strain is thrown upon the angles of the roof near the ends of the ridge pole, and they are in consequence exceedingly liable to tear open at this point, and do not wear well. They are very easily destroyed by wind, and, as a matter of fact, very large numbers of them were wrecked in Natal. They are very dark at the ends unless the whole of one side is brailed up, and they give very little headroom near the canvas. They are consequently inconvenient to work in, though they are cool and keep out the wind and the rain so long as the canvas is untorn.

Each of the other tents, the tortoise and the "E.P.," has certain advantages in common, namely: they are easy to pitch; they withstand wind very well with suitable pegs, and their canvas seldom tears; they are well ventilated, and having plenty of light and of headroom, are easy to work in and comfortable for patients; they accommodate beds with economy of space by reason of their rectangular shape.

Each of these tents has also advantages of its own.

The tortoise tent is easier to pack and to move, both because it weighs nearly 200 lbs. less than the "E.P.," and is also divisible into four segments, and for the same reason it is the easier to pitch as well. It is also the more commodious, for the 4 feet of extra length really give it space for two more beds than the "E.P." tent.

On the other hand, the "E.P." tent is both warmer in cold weather and cooler in a very hot sun than the tortoise tent. The thin inner canvas of the latter was quite enough to prevent undue heat of the sun in South Africa, but in a more tropical climate, such as India or Egypt, it is the opinion of most observers that it would not afford sufficient protection from the sun. The three layers of canvas of the "E.P." tent, which keep it cool,

PLATE XIV.

ORDNANCE STORE TENTS, used as Wards for Enteric Fever at Bloemfontein.

[*To face page* 53.

also keep it warm in severe cold, but at the same time we think that it is unnecessarily heavy, and that both the two inner layers might be made thinner without impairing its efficiency, especially if the roof canvas were attached so as to leave a considerable air space, as in the tortoise tent.

The Ordnance Tent.—This, though not intended for hospital use, makes an excellent ward, 60 feet long, for about eighteen or twenty patients, and if provided with an inner lining of canvas would, we think, prove a very useful ward tent. We used two for enteric fever patients, and found them most commodious.

The Tents of the Medical Officers and Orderlies.—We found the square bell tents of the tortoise pattern comfortable and commodious, but they are not sufficient protection against a hot sun, and should be lined inside if used in a hot climate. They are also a good pattern for orderlies' tents, and are carriageable and easy to move and to pitch, as they only weigh about 80 lbs. each.

The army pattern bell tent is a good one, and its double lining makes it both a warmer tent in cold weather and a cooler one in a hot sun. It is a circular 9-foot tent, and is consequently not nearly so roomy as the 12 feet by 9 feet square bell pattern.

The Beds and Mattresses.—The heavy iron beds of the Military Base Hospitals are quite unnecessarily heavy and wide, though very good in themselves and quite suitable for permanent buildings.

It is not necessary for a civilian hospital to equip itself with beds likely to last for many years, and consequently it is a mistake to purchase with the same object in view as in furnishing a house. A light frame, with folding legs easily secured when the bed is in use, and fitted with a strong wire-wove mattress, laced at the sides as well as at the ends so as to prevent sagging, is what is required for a Base Hospital that may have to move its position. Six feet 3 inches by 2½ feet is a suit-

able size. Wooden frames are, of course, lighter though not so durable as iron, and in some climates might cause trouble by warping, whilst in parts of Africa and India they might be possibly infested by insects or easily destroyed by ants. As a matter of fact we found no such inconveniences at all with the wooden frame beds we took, but a suitable light steel frame might perhaps be preferable if it could be made not too heavy.

Money must not be spared in the purchase of thoroughly good horse-hair mattresses, for in fracture cases and in severe enteric and dysentery alike a thoroughly firm mattress is essential to the comfort and well-being of the patient, and will help to obviate bed sores in bad cases. It is, of course, essential to provide "fracture boards," and we found they were more carriageable and easy to use made about 1 foot wide and of a suitable length to go crossways under the wire mattress; they should be half an inch thick. With regard to bedding, it only remains to mention that an extra large supply of sheets is necessary because of the frequent soiling of them in cases of dysentery and bad enteric fever, and the possible difficulties of getting them washed; that a good supply of pillows, including small down pillows, help much to make wounded men comfortable; and that red rubber bed sheeting is often useful, and should be provided. Plenty of spare blankets should be taken, so as to provide for emergency cases in excess of the proper hospital accommodation; and in connection with this subject it may be mentioned that the Royal Engineers made, very expeditiously, stretcher beds with canvas stretched across a wooden frame, which were very useful in various hospitals, and especially for convalescent cases.

Flooring of Tents.—In a wet climate it would be almost a necessity to board over the ground inside the tent, but with proper trenches it was not a necessity in South Africa.

Medical and Surgical Stores.

Drugs.—One of the advantages that a civilian has over a regulation hospital is the power, on the part of the Medical Officers, of choosing their own equipment, and this is particularly felt in the choice of drugs. In this matter the members of the staff will naturally be guided by their past experience, and choose the drugs with which they are most familiar. The list in the Appendix proved most serviceable, but is a suggestion only, and would no doubt have to be modified to meet the requirements of other Medical Officers, and also of the climate and country in which the hospital has to work.

Antiseptics, Dressings, Etc.

As far as antiseptics are concerned, the simpler they are the better, and the easier it is for orderlies to learn their use. Soloids of perchloride or biniodide of mercury and some pure phenol will meet all requirements.

Some provision for a supply of clean water should be made, and for this purpose a large copper will be most useful, and can be supplemented by the addition of a Berkefeld filter, which should be supplied with an air compression chamber to obviate the filtering cylinder being subjected to an alternating pressure. One or two small sterilisers are also essential.

Bandages should be supplied in large quantities and in various widths ; large triangular bandages are very useful for slings as well as for bandages.

In the matter of dressings simplicity is to be aimed at, and a great variety is to be avoided as unnecessarily complicating the packing, and, what is more to the point, the finding of any particular dressing when required. The Portland Hospital was supplied with plain, thymol, and cyanide gauze. The plain was taken not only as a dressing but for the making of cotton wool sponges, which we believed were the most satisfactory. The

thymol was supplied in case of irritation due to the cyanide.

We were provided with plain absorbent wool only, and took none of the impregnated varieties, nor had reason to regret our decision. Some plain lint, non-absorbent wool, and tow completed our equipment in this direction.

Some remarks on the packing of such stores may not be amiss. In the first place, all materials should be done up in small amounts and covered with some waterproof and dustproof covering. By this means convenient quantities of the dressings are always at hand, and there is but little loss from soiling consequent on the dirt or dust gaining access to an already opened package.

The Dutch ambulance that one of us saw certainly had some points worth copying. Their dressings were all done up in small rectangular packages, the wool and bandages being compressed. The shape of the packages being rectangular allowed of very close packing, and no space was lost, as must happen if round parcels are used. The dressings should be packed for transport in small boxes, such as the army use, and in each box should be an assortment of dressings and bandages, the table of contents being painted in full on the outside.

It is well to make oneself independent of marine sponges as far as possible. If these are difficult to clean at home they are more so in a campaign. Sponges made of cotton wool and covered with a layer of gauze, so as to measure about an inch and a half in diameter, are easy to manufacture in hospital, or they could be made at home and sent out in soldered tin boxes which could be made to open by means of a key, as in the case of jam or sardines.

A few linen bags which have a large turnover at the mouth will be found very useful for keeping dressings after the packages have been opened.

Plaster of Paris splints are exceedingly useful, and

the means to make them obviates the necessity of many fashioned splints. These may be provided either by ready rolled bandages, or made out of coarse flannel shaped to the limb and saturated with a thin solution of plaster.

Eucaine and cocaine are often useful, and should be taken.

Instruments and Splints.—In selecting surgical instruments, due consideration must, of course, be given to the supply of a few special instruments, such as those for the eye, ear, and throat, but a very large number of those which are necessarily in the stock of any large civilian hospital are quite unnecessary in a war hospital.

In the present days of conservative surgery a large supply of amputation knives is not necessary (we had far too many); whilst a good assortment of bone instruments of all kinds is likely to be very useful in view of the trephinings, removal of bone fragments, fixing of fractured ends, etc., which are more often required than are most other operations.

The experience of general surgeons is strongly in favour of the "telephone probe" as a bullet searcher, and there is no doubt that it will occasionally be found of use, though we did not ourselves have an opportunity of testing it.

Splints.—These are very difficult to choose, as many of them are bulky and heavy. In our opinion the selection of splints in the army "fracture boxes" is not good, and we should not again take them.

For the upper extremity we should advise a large number of angular wooden splints hinged at the elbow, and in various sizes; they may be quite light, and are easily packed. We found them of more use than any other splint for gunshot wounds of the arm and forearm. Some straight splints of various sizes for fractures of the humerus or radius and ulna, and some kettle-holder splinting, make up all that is required for the upper

extremity, though poroplastic and guttapercha may both prove of service.

For the lower extremity splints are more important, and also more difficult to carry in large numbers. For fractures of the femur we consider Hodgin's splint by far the best. It is not only easy to carry, but is especially useful in cases where there are wounds on two sides of a limb, as is so usually the case in gunshot fractures, for it permits of easy access for the application of dressings, and is much less irksome to the patient than the long straight splint. These latter also must, of course, be provided, as must some iron brackets and screws for making the necessary "interruptions," so as to suit the position of any wound there may be to dress.

For the leg some metal back splints with Salter's swings and wooden side pieces are essential for severe injuries, and some plain wooden back splints will be found useful for many cases.

Two or three MacIntyre splints of different sizes may also prove useful for injuries involving the knee joint, and these, with a few Cline's and Dupuytren's wooden splints, will make up all that is needed. All splints that can be made of aluminium should be preferred on account of their lightness.

X-Rays.

The X-ray Equipment.—In this respect the Hospital was very fully equipped. Mr Churchill was so kind as to lend us an Influence machine by Pidgeon. But unfortunately we could make no use of it. The atmospheric conditions at Rondebosch were not favourable to this form of machine, and it was almost impossible to keep sand from covering the plates and collectors with innumerable points of leakage —at least that is the only explanation we can give of the failure to get sufficient tension to give any result with the tubes.

It is, however, only fair to say that a similar apparatus

was used with success by one of the Guards' Medical Officers at Modder River.

But our experience with the coil was highly satisfactory. We took out two Lithanode batteries of six cells each, and of 30 A.H. capacity. These we had charged at the Rondebosch Electric Light Works only three times in the three months that we were there. We must here express our obligation to the manager of these works, Mr McMuldrow, for his repeated kindness and help to us in electrical matters. The batteries stood extremely well, and ran the whole time we were at Bloemfontein without recharging, never standing below 12 volts on the voltmeter.

We were, however, quite prepared to charge them ourselves if necessary, for we had a complete generating plant, *i.e.*, a small ½ h.p. horizontal engine, boiler, and dynamo. One of our orderlies was a fitter, and therefore quite at home with the engine, which, though looking at first rather a toy, turned out to be quite up to its work, that is to drive the small dynamo at a speed sufficient to charge the batteries. Strictly speaking, the batteries should have been charged regularly every week at least, but practically we found the loss so slight that we never thought this necessary, especially as fuel was scarce at Bloemfontein.

Batteries, however, are liable to give trouble, must be carried about with special care, and are apt to run down rather suddenly if much used without frequent charging; and they are no doubt destined in the future to be replaced by some other method of current generation.

Mr Hall Edwards, of the Yeomanry Hospital, has been working the coil direct from the dynamo, run by a steam engine of a larger pattern than that described above (one of about 1 h.p.), capable, that is, of developing 60 volts at least. He interposes an electrolytic interrupter, and the results are said to be very satisfactory. The objections to this method are, the size and weight of the plant, the necessity for fuel, and the time taken in preparation for the smallest observation.

Oil motors are now made so light and portable, and are so rapidly started and easy to work, that it is probable that they will in the future be the means of driving the dynamo. Dr Lewis Jones suggests that a motor tricycle could be used for this purpose very easily, besides being useful in other ways.

The coil was one of Apps's, of the pattern of which he has supplied many to the War Office. It was capable of giving a 12-inch spark under favourable circumstances. The interrupter and condenser were separate from the coil, which we think a convenience. This apparatus gave us no trouble whatever, except that the platinum contacts wore rather too rapidly, and would in the future be better if made rather longer.

We took out twelve Crooke's tubes of various makes and resistances, but finding one of them gave satisfactory results, both with screen and photography, we used no other all the time we were out. The Mackenzie-Davidson couch proved of the greatest use: but though we had the localising apparatus, we seldom had occasion to use it. The whole of this apparatus was arranged on one side of the operating tent, and proved of the greatest value in the diagnosis of the presence and position of bullets, and also in the examination of fractures of bones. In fact we may safely say that the usefulness of the Hospital would have been impaired considerably if it had gone out without the X-ray equipment.

A bell tent was reserved for photographic purposes. In this tent was set up a small dark tent, which enabled us to change plates or even to develop in broad daylight; but as a rule all X-ray work was done after dark. We had many opportunities of proving the superiority of photography over simple observation by means of the fluorescent screen, though the latter has advantages of its own.

Medical Comforts.—The food supplied in the hospitals in South Africa was most excellent, and there was an abundance of everything at the Base Hospitals at all times,

PLATE XV.

A Portland Hospital Ambulance Waggon.

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except when the destruction of bridges or railways by the enemy interfered with the transport. Nothing could have been better than the feeding of the men in the hospitals near Cape Town, and from what we heard, it was just as good in Natal. Seeing, however, that supplies may be interfered with when hospitals are moved to the advanced base, as at Bloemfontein, it is certainly advantageous to have some small supplies of stores for emergency, so as to improve the diets of some few patients under such conditions.

The most useful article of all is milk, and nothing is better than sterilised milk in bottles, were it not so impossible to carry large quantities of it in this form. As to the various brands of tinned milk, we will not attempt to decide which is best, but it is nevertheless quite clear that the unsweetened varieties are the only ones that are of much real use, and it was a common experience in all hospitals that the sweetened milks were most unpalatable to patients with enteric fever and dysentery, for whom they formed the staple diet, and in not a few cases they could not be tolerated.

Tinned or bottled soups and jellies are often most acceptable and useful, and some of each should be supplied.

Various other articles will no doubt suggest themselves, and, although they can scarcely be classed as "Medical Comforts," chess, draughts, and backgammon boards, dominoes, and a few packs of cards will be found very acceptable amongst the convalescents.

Hospital Clothing. — The army provides men with serviceable blue suits of hospital clothing, but does not undertake to provide pyjamas or nightshirts, the men being supposed to use their flannel day shirts when in bed. It is therefore useful to take out a good stock of pyjamas, and, although the army supplied excellent flannel shirts, drawers, and socks, it will be found advisable to have some of these also in stock, as well as

some caps, scarves, handkerchiefs, slippers, combs and brushes, sponges and towels, for all of which good use will be found.

Operating Tables. — Those we took were plain oak tables, 8 feet by 2½ feet, and fitted with strong square legs which screwed into sockets, and could thus be easily removed when the table required to be packed.

We had two such tables, and used one for operations, and the other to hold the sterilisers, jars with antiseptic solutions, bowls, etc. It seemed to us that such plain tables were more useful than elaborate operating tables, which were much more difficult to pack, more liable to injury, and were not really required.

Ambulance Waggons.—We do not know of any good ambulance waggons that are purchasable in this country, and those we took out ourselves left much to be desired. No waggon we have seen was suitably fitted with springs, and the best conveyance for the wounded in South Africa was in our experience the Indian Tonga.

It has been said over and over again that a perfect ambulance waggon has yet to be devised. This undoubtedly is so. Those in use in this war seemed to have one exceedingly good point, namely, their strength, but on the other hand they are very heavy, and by no means comfortable—indeed, there is no great difference between travelling in them and in the much-abused ox-waggon. The latter has no springs as a rule, and those of the ambulance are so strong that their effect is almost nil. An ambulance waggon should be built for the sole purpose of carrying the wounded, and not with an eye to general utility if need be. That weight and clumsiness are not essentials is proved by the durability of the American four-wheeled spider, which is much used in South Africa, and can travel almost anywhere. One of us had the opportunity of travelling a considerable distance in an American coach, which is built to take seventeen people besides luggage, and to

PLATE XVI.

An Army Ambulance Waggon.

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travel over the vilest of roads and drifts. These are slung on leather straps which take the place of springs. It can be said with truth that they are immensely superior in comfort to ambulance waggons over rough ground.

THE MEDICAL WORK

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CHAPTER IV

ENTERIC FEVER; "SIMPLE CONTINUED FEVER"

In a medical report of the doings of the Portland Hospital the most important place must be given to the consideration of enteric fever, without which scourge, it must be remembered, the medical casualties of this campaign would have been comparatively insignificant.

A few remarks on the spread of the disease as it presented itself to our experience may not be out of place here. One of us had the opportunity of investigating the outbreak among the troops encamped at Modder River before the general advance by Lord Roberts, and in addition to this, our knowledge was gained principally from the experience of the hospital encamped at Bloemfontein when the epidemic was at its height.

Origin of the Epidemic.—Apparently for some years enteric fever has been endemic in South Africa. As in England, the disease lies dormant during the winter months, to reappear with the warm weather, and it is therefore reasonable to assume that the disease was not brought out by the army, but acquired in the country. The experience of the Guards in this connection is instructive. By the kindness of Col. Magill, Principal Medical Officer of the Guards' Hospital at Modder River, one of us was shown the admission and discharge book of the hospital, and it was evident from this that enteric fever was almost unknown until about 25th December, though

the Guards had been fighting and marching for a month before that date. About this time four cases were recorded in men of the same company, who were known to be friends, and who had drunk water at a farm, and therefore were probably all infected at the same time. From the date of this commencement enteric was a common feature in the daily record.

The Guards arrived in South Africa in the latter end of November 1899, and they proceeded after disembarkation straight up to Orange River, where they halted for two or three days.

The battle of Belmont was fought on 23rd November; Enslin on the 25th; Modder River on the 28th; and Magersfontein on 11th December. The long wait of the troops began on 12th December 1899.

The date of infection of the first cases of enteric fever, above alluded to, must, of course, be a matter of speculation entirely; but putting the incubation period at the outside at three weeks, we must conclude that this infection most probably originated at or in the vicinity of Modder River.

Modder River, which had now become the site of a great camp of at least 40,000 troops of all arms, consists of a station, a small hotel used as the headquarters of the staff, a store, and a school-house, all about the station. There were several other small farm and dwelling-houses, and little hotels, mostly on the banks of the two rivers. The Modder and Riet rivers join south of the station to form one river, which retains the name of the Riet.

The two rivers are well wooded and picturesque, and serve in peace times as a pleasure resort for the people of Kimberley.

Kimberley is regularly visited by enteric fever, and it is therefore quite possible that the soil about Modder River may have become contaminated. It was not definitely known whether, at this time, there was any direct contamination of the Modder above, but there is

PLATE XVII.

BATHING AND WASHING CLOTHES AT MODDER RIVER CAMP.

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no doubt there were cases of enteric fever at Jacobsdal on the Riet, about ten miles above the camp.

Some idea of the rate of progress of the epidemic at this time may be gained by consideration of the following figures, which, however, probably considerably understate the truth. Up to 29th January 97 cases had been reported and 17 deaths. On 6th February the total had reached 156 and 27 deaths. These figures seem small, but they were fairly evenly spread over the whole number of regiments encamped, indicating a wide distribution.

On 13th February the engagement of Klip Drift took place, the general advance having begun some days before. Jacobsdal was occupied on 16th February, and the next day Paardeberg was surrounded. Ten days were spent around Paardeberg, which surrendered on the 27th.

Bloemfontein was occupied on 13th March, about a month after the move from Modder River.

It is of course impossible to say to what extent the troops were infected on this long march, but there is little doubt that men were falling out all the time, sick with enteric fever, and that these men in all probability had been infected at Modder River.

The Bloemfontein epidemic therefore may be regarded as the natural sequel of that of Modder River.

The Dissemination of the Disease.—An epidemic does not appear to assume alarming proportions while an army is on the march, but the conditions among troops encamped are very favourable for the dissemination of the disease, and this was especially the case in the camps now under consideration.

The most obvious factors in the spread of the disease are:—

1. *Water.*—The *water supply of the Modder River Station Camp* was in the main that of the Modder and Riet rivers; but that of the headquarters staff, which was

lodged at the hotel near the station, was a well behind the hotel. This water was clear, and looked good, but the chemical analysis was actually less favourable than that of the river itself. The troops generally drew their water from the two rivers. This water was thick and muddy, but not unpalatable even in its natural state. It was liable to contamination from various sources in its course, mainly dead horses and possibly dead Boers; moreover there was said to be enteric at Jacobsdal above. Various methods were used by many regiments to purify the water drawn from the Modder; these were boiling and clearing by the addition of a small quantity of alum, and filtering by the Berkefeld and Pasteur filters; but in spite of all precautions the vast majority of soldiers filled their bottles straight from the river above the drift. Latterly some six or seven wells were sunk about 30 feet from the river, but these do not seem to have been used very much.

The *water supply of Bloemfontein* was very restricted at first, from the fact that the water-works were in the possession of the enemy for about a month, and were only recaptured at the end of April. During this time Bloemfontein spring and certain wells were the only source of supply. Of these the spring was the most important. It is situated to the west of the town, close under the Residency. The water looked clear and good, but the chemical analysis was unfavourable There was a large donga about 50 feet from it, and at a slightly higher level than it, but separated from it by a high bank. There was no reason to suppose that there was any communication between the spring and this donga, but it must be noted that the donga was formed by the confluence of two smaller dongas, which practically drained a large camp area west of the town, occupied, in fact, by the whole of the 6th Division; also that on the banks of one branch was a Field Hospital with at least sixty enteric cases in it at the time of observa-

PLATE XVIII.

TUBE WELLS AT BLOEMFONTEIN.

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tion. These dongas are dry in the dry season, during which time they accumulate a great quantity of refuse, fæcal, and other dangerous matter; but when the rain falls they become torrents for a time, as we had ample opportunity of seeing for ourselves. We cannot therefore exclude the possibility of contamination of the Bloemfontein spring, though it is scarcely probable.

Close to the site chosen for the Portland Hospital Camp, near a clump of trees known as the "Willows," were two tube wells, from which, after 12th April, a good supply of excellent water was drawn. Another well was bored close to the Willows, and these three wells were made great use of by the camps near them, especially by No. 8 General Hospital and the Portland. These wells were bored deeply into solid rock, one of them was 170 feet deep, and contamination from surface drainage was practically impossible. Other wells existed in the town and to the east, but of these we know nothing.

After the arrival of the Portland Hospital one of its staff was placed upon a Board which was appointed to inquire into the water supply and the precautions necessary for checking the spread of the fever, and as a result the bucket system of drainage was ordered to be adopted in all camps and hospitals. This was carried out fairly thoroughly, and the old open trench latrines done away with. After the beginning of May, when the supply from the water-works was renewed, an analysis was made of water from the town main (Appendix G). This was not satisfactory, and it was suggested by us with reason that the mains having been so long stagnant might have become contaminated, so after a time another analysis was made (Appendix G), but this being still unsatisfactory, one was made of the water from the Modder River reservoir (Appendix G) as a control. This was not above suspicion, but as the possibility of contamination at the source was not great, it is probable that the organic matter as shown by analysis might be only vegetable.

In conclusion, it will be seen that both at Modder River Station and Bloemfontein the water supply was open to question, but it is probable that water did not play an all-important part in the dissemination of the disease. This is a matter of opinion only, for as far as we know no *bacterial* examination of the water was ever made, and without that no analysis can be said to be of absolute value. A consideration of the number of officers suffering from the disease has some interest in this discussion. Officers, as a rule, are much more careful in the matter of drinking water than the men, and many drank nothing but boiled water, yet the percentage of officers affected is probably very high, for at our Hospital, out of a total of seventy sick officers thirty-three were cases of enteric fever, that is 47.1 per cent., while the percentage of enteric cases among the sick men was 33 per cent.

2. *Dust and Sand Storms.*—In our opinion these are very important factors in the spread of the disease. Whenever the wind blew strongly, which it did most days for a time, and sometimes all day at Modder River Station, the camps were smothered in dust. No tent, however carefully closed, could keep it out. The food at such times was full of sand; and bedding, clothes, and baggage were full of dust. The latrines were all of the open trench form at this time, and the atmosphere being intensely dry, the dust from these latrines must have blown about with the rest. In a camp of this size (there were 40,000 men in it at the time one of us was there) there must at any time have been many men with enteric walking about, and it is not therefore too much to say that many of the ordinary latrines contained enteric evacuations. Moreover, a day never passed without the appearance of one or more local whirlwinds, called "sand devils," by means of which light articles, paper, etc., were whirled up high into the air and deposited all over the camp. Under these conditions the water supply as a medium of spreading the disease seems to take almost a secondary position. At Bloemfontein

these same forces were at work, but to a less striking degree than at Modder River, probably because the season of the year was less favourable to them.

3. *Flies* seem to have a special attraction to enteric fever patients. In a tent full of men, all apparently equally ill, one may almost pick out the enteric cases by the masses of flies that they attract. This was very noticeable at Modder River, for at that time there were in many tents men with severe sunstroke who resembled in some ways enteric patients, and it was remarkable to see how the flies passed over them to hover round and settle on the enterics. The moment an enteric patient put out his tongue one or more flies would settle on it.

At Bloemfontein the flies were a perfect pest; they were everywhere, and in and on every article of food. It is impossible not to regard them as most important factors in the dissemination of enteric fever. Our opinion is further strengthened by the fact that enteric fever in South Africa practically ceases every year with the cold weather, and this was the case at Bloemfontein. For though the days after about 10 A.M. are as warm as an English summer day, and the temperature in our tents at mid-day was rarely below 70° F. and often about 80° F., the nights are very cold and often frosty, and with the cold nights the flies disappeared. It seemed to us that the cold weather reduced the number of the enteric cases by killing these pests.

Since our return, Dr Schölberg has made cultivations, at the laboratory of St Bartholomew's Hospital, from the excreta of flies voided on temperature charts which had been kept in the enteric tents, in the hope of isolating the bacillus enteritidis, but with a negative result as far as that particular bacillus is concerned, though there was a plentiful growth of other organisms. This failure to demonstrate the typhoid bacillus is not a matter for surprise considering the time that had elapsed (three months at least), and that the bacilli might have been

destroyed in the alimentary canal of the insect. It is also probable that the organisms are carried about on the legs and bodies of flies as well as in their digestive organs.

4. *Personal Infection from Man to Man.*—The mode of life of the soldier on active service offers every facility for personal infection from one man to another.

It would be impossible to find a more favourable field for the growth and propagation of the enteric bacillus than an army composed of mostly young men, as ours is. The long insidious prodromal period ensures that the infected man shall be among his fellows for a considerable time before he feels ill enough to report himself sick, and there can be no doubt that many men go through a slight attack and return to duty.

It is now well known that persons are infectious at an early date in the disease, and for an undetermined period afterwards—in some a period of years. It is also known that the fæces are not by any means the only channel by which the bacilli are removed from the body, for the urine also may contain them in great numbers. In the light of recent investigations on this point, most ably discussed by Dr Horton-Smith in his *Goulstonian Lectures*, 1900, it is quite unjustifiable to allow any man to return to duty which involves camp life after an attack of enteric fever, however slight, except after a long interval, the extent of which has yet to be determined. The intercourse between the men in camp is necessarily very close. At least fifteen sleep in a bell tent, sometimes more, and this offers plenty of possibilities in the way of infection; besides those which are inseparable from the frequent common use of eating and drinking utensils. The opportunities for general cleanliness are never great, and often water cannot be spared for purposes other than drinking. In fact, all things considered, it is a matter for wonder that the number of men stricken with the disease was not greater than it was.

5. *The Probable Influence of Certain Conditions antecedent to the Onset of the Disease.*—The supposed influence of the toxins of other organisms upon the growth and virulence of the enteric bacilli deserves special notice here, as a probable explanation of the extraordinary vulnerability of the soldier to infection, and also of the extreme severity of many of the cases.

We cannot do better than quote a passage from Dr Horton-Smith's *Goulstonian Lectures* (1900, p. 35) in this connection :—

"Sanarelli showed . . . that all that is necessary is to inject into a guinea-pig at first a dose (of enteric bacilli) not quite sufficient to be fatal. The animal recovers, but for some time afterwards attenuated typhoid bacilli may be found in the purulent focus at the seat of inoculation. If now, in this condition, a dose of toxines, either of B. coli or of B. proteus vulgaris, be injected into the peritoneum, the typhoid bacilli at once acquire fresh virulence, the organism is invaded afresh, and the animal dies from acute experimental typhoid fever. More important still, on two occasions he was able to determine such a relapse by injecting small quantities of the toxin into the stomach and so into the intestines, thus exactly reproducing the conditions occurring in the human subject."

The principle established by this experiment seems to us to throw a flood of light upon the subject of infection. It is conceivable that many healthy men may have received the bacilli into their alimentary canals, or even into their circulation, without any impairment of health. That this is possible is shown by the fact that after enteric fever, the bacilli have been found in the tissues after long lapses of time—years even—without harm to the patients. But if another toxin should appear in the body, these apparently harmless bacilli wake up to take on a new virulence and activity, and the disease is established.

It is quite possible that a gastro-enteritis with multiplication of B. coli, and liberation of its toxin, in ordinary

circumstances of little moment, may be sufficient to start this process; still more so a specific diarrhœa or dysentery. In fact we found that many of our patients had been suffering from dysentery for a time before the onset of enteric fever. Is it not possible that the dysenteric attack may have determined the enteric?

From this point of view, diarrhœa, specific or simple, acquires a new and somewhat lurid interest, and calls for, more than ever, early and careful treatment.

Statistics relating to Enteric Fever and Inoculation.

If these remarks have any value it would appear in the present state of knowledge to be almost impossible to combat hygienically the spread of enteric in any army under similar conditions, and it must be remembered that these are the conditions under which most of our campaigns are carried on in India, Egypt, and Africa. We therefore turn naturally to the question of the establishment of an artificial immunity in the individual soldier from this greatest of all scourges.

Inoculation against enteric has excited the greatest interest in the medical history of this campaign. Our experience unfortunately covers only a small part of the ground, but such as it is we now record it.

The Personnel of the Portland Hospital.—The strength of the Portland Hospital was forty-one persons, including sisters and servants. Of these, twenty-four non-commissioned officers and orderlies were inoculated on the voyage out, and four of the medical staff also were inoculated. Of these, all showed the local symptoms well-marked, *i.e.*, pain and stiffness and local erythema. Seventeen presented well-marked constitutional symptoms in addition, *i.e.*, general feeling of illness, rise of temperature, and headache. Of the orderlies nine had enteric fever subsequently, as had also one of the sisters. Two of these orderlies, both of

whom had refused to be inoculated, had it very severely, and one of them died ; the others had been inoculated, and of these, five had the disease lightly and two fairly severely.

These facts are shown in the following table :—

Personnel.		Inoculated.	Not Inoculated.	Had Enteric.	Died.
Medical Staff .	5	4	1	0	0
Sisters . .	4*	0	4	1	0
N.C.O.'s, Orderlies, and Servants . .	32	24	8	9	1 †
Total Strength .	41	28	13	10	1

* Two New Zealand Sisters joined the Hospital at Bloemfontein, and were finally replaced by Miss Harland.

† Had not been inoculated.

Officers and Men admitted to the Hospital.—We do not consider in these figures patients who were admitted to the Hospital as convalescents, who would yet appear in our admission and discharge book as enteric cases, but only those who were directly under our care during their illness. If we included all the former our mortality would, of course, be much lower.

We have notes of 232 enteric fever cases (including those among our own personnel), most of which came under our care while at Bloemfontein. Among these we find that fifty-four gave a history of having been inoculated before coming out or on the voyage out, that is, 23.2 per cent. of the whole number of officers and men. Of the inoculated cases four died, making a percentage of deaths from enteric fever among inoculated patients of 7.4 per cent.

Of the non-inoculated cases twenty-five died, that is, 14.0 per cent.

The total percentage of deaths among our enteric cases amounts to 12.5 per cent. only, and we are inclined to attribute this low death-rate to the fact that we were not overcrowded with more cases than we could fairly undertake to nurse and treat.

On the other hand, the percentage would have been lower if we had not had twenty-seven enteric cases transferred in one batch, on 18th May, when we had orders to receive into whatever empty beds we had the worst of the hundred or two cases in No. 12 Brigade Field Hospital, which had to be emptied so as to join in the general advance. Seven of these died, several of them being moribund at the time of admission.

The results are tabulated as follows :—

Enteric Fever.	Recovered.		Died.	
	Inoculated.	Not Inoculated.	Inoculated.	Not Inoculated.
			Per cent.	Per cent.
Officers . . 34	21	12	0	1 = 7.6
N.C.O.'s & Men 198	29	141	4 = 12.1	24 = 14.6
Total . 232	50	153	4 = 7.4	25 = 14

The percentages in the last two columns represent the mortality of inoculated cases as compared with that of the non-inoculated patients, and the figures, as will be seen, are very much in favour of the inoculated.

An attack of enteric fever is supposed to confer immunity from the disease for a longer or shorter period, and in the main this must be true, but in six of our cases there was a distinct history of a previous attack; in one the patient said he had had the disease twice, and in another so lately as a year ago, when he had a very

severe attack. If in some persons the immunity conferred by the disease itself is so slight, we can hardly expect very great things from inoculation in such cases.

Remarks on Inoculation.—The figures above given, though small, and our general impression from observation of the individual cases, are distinctly favourable to inoculation. There were undoubtedly severe cases among the inoculated, but these were few, and the greater number were mild both as regards symptoms and duration—in fact in several the disease might almost be described as abortive. The mortality at our Hospital among inoculated cases, as compared with that of the non-inoculated, was small (7.4 per cent.). There were only four deaths. One man died quite suddenly during convalescence from embolism of the pulmonary artery, another was found post-mortem to have had septic pneumonia, and one man died of pneumonia which was not apparently septic. Three therefore died of complications.

Inoculation is still on its trial, and even if the larger figures of the whole army, yet to be published, are not so favourable as these, it must not be judged too hardly. The natural immunity possessed by certain individuals on the one hand, and the extremely small amount possessed by others on the other, is so undeterminable that nothing but experiment on the most extensive scale and careful record can possibly enlighten us. In some, for instance, even the immunity conferred by an attack of the disease is so slight that they may acquire it again within a year, whereas numbers of non-inoculated officers and men who must have taken the bacilli into their alimentary canals many times have not had the disease. It is on cases which fall between these two extremes that inoculation may probably be of the greatest use.

We are inclined to think that valuable information may be gained from the manner in which the individual reacts to the injected toxin. The effect of an injection of 1 grm. of the toxin is rapid and striking, locally and constitution-

ally. The local effects are almost invariably present. In about an hour after the operation, or even in a few minutes, more or less severe pain is felt at the site of the puncture, with a spreading erythema and feeling of stiffness, and with later a certain amount of lymphangitis. The constitutional effects make themselves evident in an hour or two, and include a rise of temperature to 100°, 103°, or even more; there may be also within two hours or so a distinct rigor. Our inoculations were done at about 7 P.M., and were generally followed by a restless or sleepless night. The next day there was still some rise of temperature with headache, but the latter was much relieved by a purge, so that we found that a purge given at the time of the inoculation would often prevent this headache. Faintness on getting up at any time during the first ten hours was not uncommon. The temperature was usually normal on the following evening.

Many persons seem to escape the constitutional symptoms, but nearly all have the local. Our strong impression is that the manner in which a person reacts to inoculation is some indication of his degree of natural immunity. Thus an individual who presents little or no constitutional disturbance is probably unlikely to suffer badly from the disease if he is so unfortunate as to get it subsequently. It is possible that repeated inoculation might render him absolutely safe for a period of time yet to be determined. But a person who shows a brisk constitutional reaction should be urged strongly to be re-inoculated several times, until he ceases to develop any constitutional symptoms at all; although it is conceivable that in some cases such a state might never be reached. Unfortunately, however, the more serious the constitutional symptoms are, the less likely is the victim of them to subject himself to a similar experience, and if this is so among educated officers, it is still more so among the rank and file. However, as our knowledge of the results grows, the medical profession will be able to exert their influence

more strongly in favour of re-inoculation than they have at present been able to do.

After inoculation the blood gives the "clumping" reaction of Widal. It is not yet determined what limit of time can be assigned for the appearance and disappearance of this reaction. In the case of one of us, however, a well-marked reaction was made out three months after inoculation, and a faint one thirteen months after. It is possible that the reaction is, to a certain extent, a measure of the degree of acquired immunity.

The Epidemic in South Africa.—It is not our intention to write a treatise on enteric fever, but merely to record such interesting points as fell under our notice, especially those which bear upon prognosis and treatment.

Onset.—Generally speaking, in the majority of cases the onset of the disease is as insidious and difficult to date as it is in England. But it is well known among army medical officers that in tropical climates the disease may begin quite suddenly, and this was so with some of our patients. This was very much the case at Modder River, where men were brought in from outpost duty, having suddenly fainted, and were then found to have a high temperature. Such cases were often mistaken for sunstroke, and in fact some of them may have been of that nature. It is conceivable that a man may be in the early prodromal stage of enteric fever, and therefore more liable to insolation than he would otherwise be. When taken ill, he may therefore be actually suffering from sunstroke, and the symptoms of this may insensibly merge into those of enteric fever, so that the sudden onset viewed in that light is a mere accident. We may remark in passing that several of our wounded patients developed enteric fever a short time after admission, and that others were wounded when in the second week of the disease and suffering from considerable pyrexia.

Course.—The more serious cases almost invariably

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suffered from severe headache, generally frontal. This headache usually ceased about the eleventh day of the disease; it was, as a rule, much relieved by phenacetin or antipyrin in small doses. In two or three cases myalgic pains all over the body were so prominent a symptom as to obscure the diagnosis completely for a day or two.

Mental dulness was extremely common, and as a variety of this a change of temperament, markedly a curiously sullen mental condition, so that it was quite difficult to realise sometimes that a cheerful, good-tempered convalescent was the same man who had been so stolid and apparently discontented on admission. In one case the patient was the subject of acute mania that required constant watching; this came on on the ninth day, and lasted for about two days. Delirium, on the whole, was not so common as one would expect, considering the severity of the cases. Eighteen patients suffered from extreme deafness, and several more had it in a minor degree, and we thought it contributed probably to the general mental obtuseness so often seen. This deafness seemed to consist in a want of sensibility to rapid vibrations, so that a low voice was distinctly more audible than sounds in the higher register. This was very noticeable in an officer who was seen by one of us at Bloemfontein; he could hear quite easily the voice of the medical officer, while his wife was quite unable to make herself understood by him, to her great distress. These aural symptoms generally continued until the temperature fell, when they rather rapidly disappeared.

In many of the long severe cases there persisted well into the convalescent stage a condition of mental imbecility or childishness.

A noteworthy feature was that in some of the very worst cases, even when a fatal termination was imminent, the patient was possessed of a remarkable sense of well-being, expressing himself as feeling perfectly well; this

was noticed in officers as well as men, and was to be regarded as an unfavourable circumstance.

A very constant symptom was insomnia, but it was often difficult to determine how much of this was real or imaginary. It is probable that true refreshing sleep is rarely enjoyed by such patients, but it is certain that the patient's report about his night did not always tally with that of the attendant, who would often report that to all appearances he had slept a great part of the night. It is important to bear this in mind in treatment, for it is more than likely that, considering the feeble mental condition of such patients, a craving for hypnotics may easily become established, which may give considerable trouble afterwards.

Temperature.—This was generally high for the first week, at any rate; it was quite commonly above 104° F., and sometimes above 105°. The height of the fever was not necessarily an index of the gravity of the attack, and it was generally noticed that cases in which the temperature was continuously high during the first week ran a benign course, while low temperatures with large diurnal variations were liable to complications and relapse. The course of the fever was very long in some of the uncomplicated cases,—in one, for instance, ninety-nine days, and in another seventy-six. Thinking that it would be of interest to compare the average duration of the fever in the inoculated with that in the non-inoculated, we find that in the former it is about thirty days, and in the latter about thirty-two days, but nevertheless there can be no doubt in our minds that most of the inoculated cases ran a milder course than the non-inoculated.

Rose Spots.—In spite of assertions that have been made to the contrary, we found the characteristic eruption in half our cases, *i.e.* 118, or 50.8 per cent. The spots appeared about the eighth day, and in some the crop was very profuse and distributed all over the trunk. In one fatal case the spots themselves became purpuric, and in several

of the severe cases a purpuric eruption was noticed in addition; this was sometimes situated about the region of the epigastrium, and in one or two patients about the knees.

Pulse.—Repeated observations of the pulse rate and character were of the greatest value. In a case which is running a benign, uncomplicated course the pulse rate should not rise above 90-100, even though the temperature be very high, 104° or more. In many such cases the pulse kept between 70 and 80. This want of correspondence between pulse and temperature is peculiar to enteric (but it may also occur in meningitis), and, as a rule, when it existed a favourable prognosis was justified by the event. On the other hand, a rapid pulse always gave rise to grave apprehension, and was often a warning of complications. Fifty-one of our patients had rapid pulses, and of these twenty-one died, a percentage of 41.1. Some of these died of complications, but a fair number showed no sufficient cause of death post-mortem, and the inference we drew was that they died of heart failure due to the intensity of the poison. But though tachycardia is a serious symptom, it is by no means necessarily a fatal one, for thirty such cases recovered. In these again, complications such as lung troubles or hæmorrhage, for instance, were known to exist, but in several no evidence of such was to be found. In a few cases a rapid pulse was established during convalescence without any discoverable reason, such a pulse, for instance, as 160 to the minute. It was curious that the patient was not in any way conscious of this, also that on lying down the pulse rate slowed at least 20 beats. This condition would last for a week or a fortnight and then gradually subside. There appeared to be no danger attaching to it. It is possible that the high altitude of Bloemfontein may have had something to do with it, but more probable that it was due to the heart muscle sharing the general muscular feebleness and malnutrition.

Irregularity of pulse is always regarded as of evil omen. It was noticed in six cases only, and therefore was rather a rare event. Of these cases two only were fatal, and in others the irregularity appeared about the fourth week, and then only for a short time; in two of them it amounted to nothing more than an occasional intermission.

Tongue.—The state of the tongue in the large majority of our patients was characteristic, so much so that it proved of the greatest assistance in diagnosis. The brownish, dry, central streak was the rule, with few exceptions. The severity of the attack was almost proportional to the amount of dryness and sordid condition of the tongue and mouth, but this was a symptom that fortunately lent itself to treatment, much to the comfort of the patient.

Diarrhœa has been regarded by many as a necessary part of the disease, and some physicians are reluctant to treat it, regarding it as nature's effort to remove poisonous products. This is not our opinion, and, speaking generally, we found that the constipated cases, which were happily common, were our best and most favourable cases. So much were we impressed by this, that we made it a rule to treat diarrhœa, regarding anything over three *loose stools* in the day as indicating treatment, and we consider this sound practice. We are inclined to think that in many cases, if not all, diarrhœa is not necessarily due to the affection of the Peyer's patches in the small intestine, but to a certain degree of implication of the mucous membrane of the large intestine, and this we verified in several of our post-mortem examinations (see p. 102). However this may be, we have no doubt that treatment is called for, and that so debilitating a complication can only have a harmful effect on the course of the case (see *Treatment*).

That this is more than a mere opinion is shown, we think, by the fact that out of twenty-nine deaths from enteric fever twenty-one patients had more or less severe

diarrhœa, while six only could be said to be constipated cases.

Relapsing Cases were few, comparatively speaking, seven only. In all of them the relapse occurred after the fifth week, with one exception. This was an inoculated patient, in whom the temperature fell on the sixteenth day, then was subnormal for two days only, and rose again, not becoming normal until the forty-ninth day. Perhaps it is doubtful whether this should be called a relapse, for it was not at all uncommon to see a general remission in the temperature about the seventeenth or eighteenth day, and we have not looked upon these as relapsing cases. Our experience of relapsing cases has confirmed us in the generally accepted opinion, that such cases do well. Beyond the annoying prolongation of the convalescence, no ill effects have followed.

Malignant Cases.—Our experience at Bloemfontein was so striking, especially at the time when the epidemic was at its height, before the general advance, that it deserves special notice. Among the patients admitted to hospital were cases of the most virulent type that we have ever seen. Men were brought in unable even to give their names. Man after man died without any evidence of complication. Post-mortem examination revealed nothing but the ordinary intestinal lesions. From such examination it was impossible to say why they died, but it was assumed that death resulted from the intense virulence of the poison. In some the heart muscle was flabby, suggesting heart failure, and in fact we were inclined to think this the most common proximate cause of death. In those patients who ultimately recovered, the period of convalescence was extraordinarily prolonged. General weakness and debility was extreme, and the bodily wasting intense. The pulse was rapid all through, well into convalescence. In one or two men, for instance, it was as rapid as 156 per minute, and there was a difference of 20 beats per minute between the standing and lying

posture, even in patients who in other respects were well enough to be discharged. In several of these malignant cases purpuric eruptions appeared, which, taken with the post-mortem appearances, suggested that septicæmia, due to organisms other than enteric, might play some part in the disease. In four of these patients we tried streptococcus antitoxin, but without any appreciable result, for three of them died, and we cannot attribute the recovery of the fourth to the use of it.

Complications.

Lungs.—Bronchitis, so common in England, was found in comparatively few patients—twenty-six cases, or 11.2 per cent. Such as there was, moreover, yielded quickly to treatment. This is all the more remarkable when we consider that numbers of our patients were brought in from lying on the veld, poorly clad, and with only a blanket to cover them, brought also in ox-waggons for long distances. The nights were often intensely cold, so that we in tents had a difficulty in keeping ourselves warm at night. It is probable that the fine dry air of the high plateau, 3500 feet altitude, has much to do with the freedom from catarrhal complications, such as bronchitis.

We might here mention three cases of Cheyne-Stokes respiration. One of these was quite typical, occurring during sleep only, at the end of the main attack, and also at the end of a relapse. The same patient also had an intermittent pulse at about the same time. He eventually recovered. Another man presented the same phenomenon, but not quite so typically as the last, and he also recovered. The third died.

Pneumonia was still more uncommon—three cases only. Post-mortem we found the lungs affected in eight cases. Of these a pneumonia was found resembling the lobar form in one only. On the other hand seven showed one or more small patches of consolidation, with distinct, sinuous, limiting walls, and indistinguishable from those

patches of septic infarction that are so common in pyæmic cases.

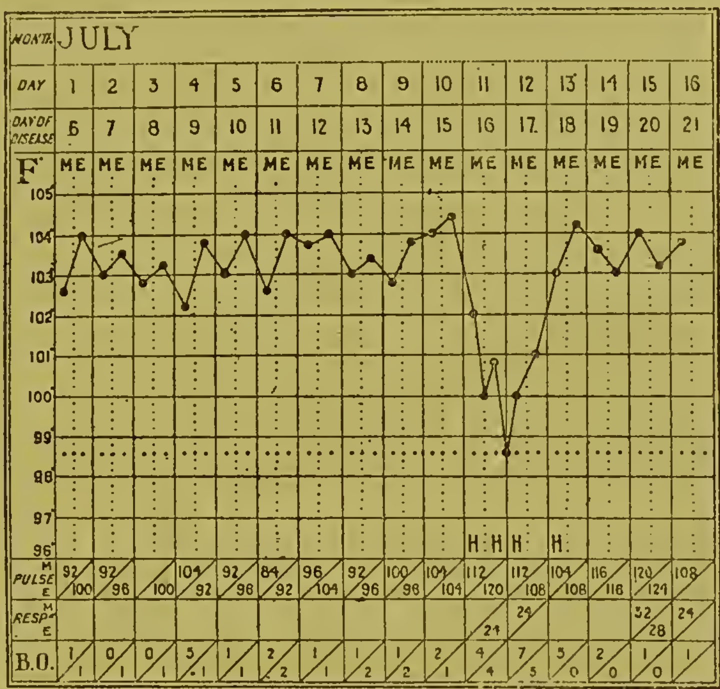
One of our patients during convalescence died quite suddenly while sitting up in bed, and post-mortem we found a large recent plug of clot in the pulmonary artery. It is probable that it was detached from a mass of clot that was found in the right auricle. The case had been a mild one in an inoculated person, and there was nothing in the course of the disease to warn us that so untoward an event was impending.

Hæmorrhage occurred in ten cases, generally at about the eighteenth day. In some it was very severe and was repeated two or three times, and was so profuse in one or two cases as to lead to considerable blanching. It was almost invariably associated with a sudden fall of temperature, and invariably with a rise in the pulse rate.

In only one case was it found after death when it had not been suspected during life. Four of the cases of hæmorrhage died, but there is no reason to suppose that in them the hæmorrhage was the proximate cause of death, —that is, no blood was found in the intestines at the necropsy.

CASE I.—Corporal V. D.; had been inoculated on the voyage out; admitted 1st July; had been feeling ill for six days with headache and diarrhœa. On admission, the patient was fairly comfortable, but his tongue was thickly furred and brownish; temperature 102.6°, and pulse 92. Abdomen natural, no spots, and no diarrhœa. Spots appeared on the tenth day. The temperature kept high, and the patient became deaf, but the pulse did not exceed 100 until the fifteenth day (see Chart), when there was a profuse hæmorrhage with rapid fall of the temperature to the normal, and at the same time a rise in the pulse rate. The hæmorrhage seemed to yield to treatment, and in three days the temperature was high again, but the pulse remained at about 120, and on the whole the patient did not seem

much the worse. He was transferred on the breaking-up of the Hospital, and therefore we cannot record the details



Case I.—Enteric Fever. Hæmorrhage.

of his subsequent history, but we learn that he had at least two other severe attacks of hæmorrhage, although when last heard of he was well on the way towards convalescence.

Perforation occurred in five of our patients, averaging on the thirty-fifth day. The earliest day of occurrence was the nineteenth and the latest the fifty-first day. The accident was associated always with some alteration in the temperature, generally a fall with rapid subsequent rise. All complained of pain in the abdomen, which was generally of sudden onset. The pulse and respiration invariably were greatly accelerated, and in fact there can be no doubt that a rapidly rising pulse rate is one of the surest guides in the diagnosis of perforation. Two of our patients who ultimately recovered, but who were extremely anxious cases, had in the course of the disease an attack of very severe pain in the abdomen—in one so

severe as to cause profuse sweating and collapse, but the pulse was unaltered, and though in other respects perforation seemed likely, the absence of acceleration of pulse led us to suspect colic, which diagnosis was probably correct.

The absence of the liver dulness cannot be relied upon as a sign, for it (the dulness) was demonstrable in most of our cases. This is probably owing to the insidious but rapid spread of general inflammation causing the peritoneal surfaces to become strongly adherent, thus preventing the escape of gas or fluid into the peritoneal cavity.

The following cases will serve to illustrate these remarks on perforation :—

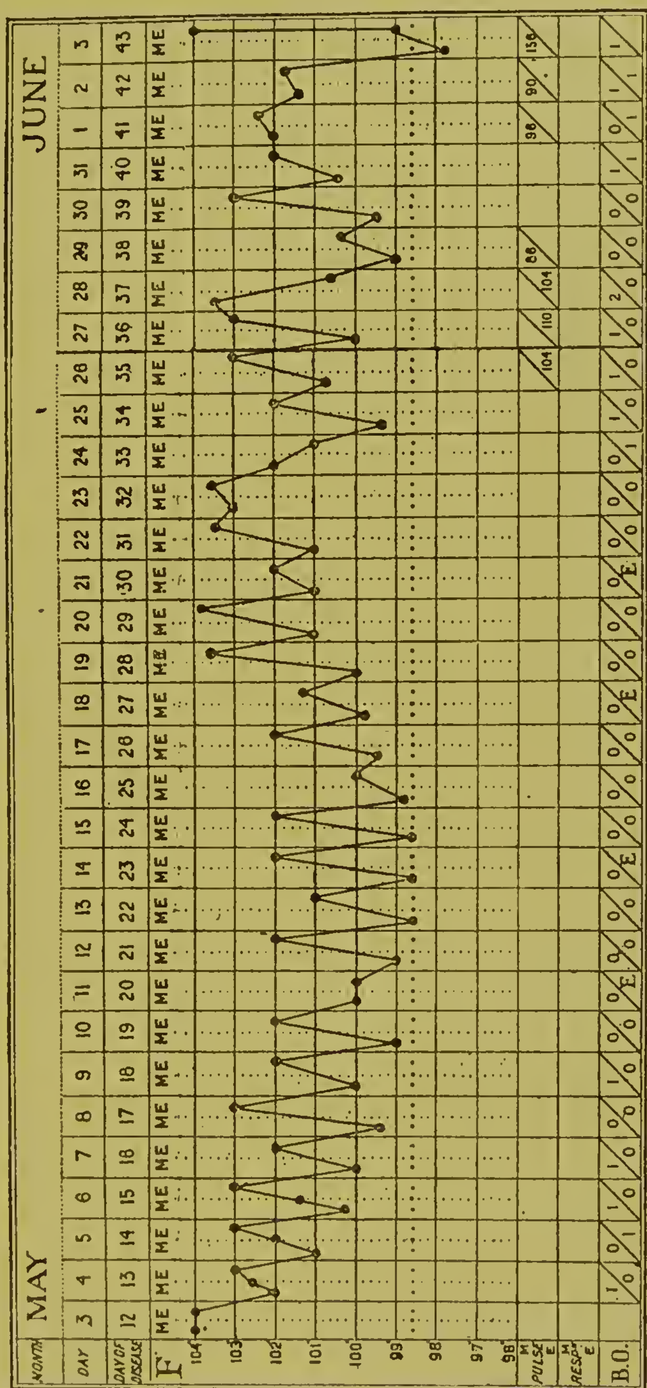
CASE II.—Quartermaster-Sergeant C. B., æt. 35, was admitted on 3rd May 1900, on the twelfth day of his illness. A week before admission he had become suddenly extremely deaf. He did not appear to be ill generally, but his night temperature was between 102° and 104° for three weeks, and his morning temperature was usually between 2° and 3° lower. His pulse was rarely over 100. A few rose spots were seen after admission, and his bowels were generally rather constipated. It was considered that he had a comparatively mild attack of enteric fever.

May 27.—The thirty-seventh day of the disease, he began to suffer from pain in the umbilical region. There was no tympanites, but the pulse rate rose to 110. This pain was much relieved by belladonna fomentations, and though the temperature still kept above normal, the pulse rate fell again to 96, and all seemed to be going on well.

June 2.—About midnight the abdominal pain began again rather suddenly.

June 3.—In great pain; passed two motions under him. Breathing rapidly, 48 per minute. Pulse rate 156.

Abdomen moves freely, and there is little distension. Temperature rose to 104°, and he died at 2 P.M.



CASE II.—ENTERIC FEVER. PERFORATION.

Post-Mortem.—There was found marked general peritonitis; the pelvis was full of purulent fluid, but there

was no fæcal matter in it. A perforation was found about 18 inches from the valve. It was in the floor of a deep ulcer with slightly raised edges. There were two or three other ulcers, healing.

Remarks.—It is possible that the first attack of pain may have been due to a perforation which had been rapidly sealed up by local peritonitis, and that the second attack was due to generalisation of the peritonitis. The post-mortem appearances certainly suggested that perforation had taken place several days before death. The question of operation was discussed on 2nd June, but the general condition became very rapidly so unfavourable that it was decided to leave him alone.

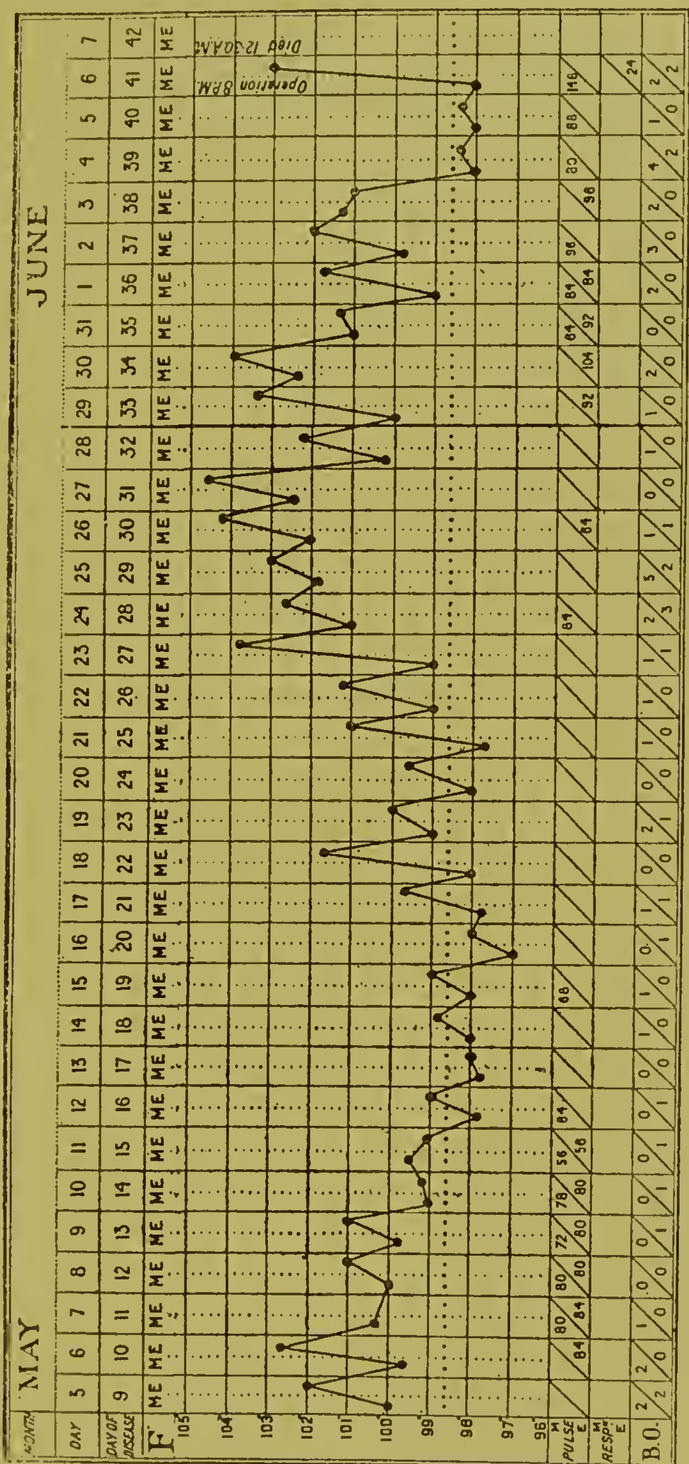
CASE III.—Sergeant G. H., æt. 28, admitted 5th May 1900; had been feeling ill for eight days before. He was rather ill on admission, with the characteristic dry, brown tongue with central streak, a pulse rate of 72, and a temperature of 102° to 103° at night. On the sixteenth day of the disease the temperature became normal, the pulse rate varied from 56 to 70, and the patient felt and looked perfectly well. This went on for six days, when the temperature began to mount again (the Chart resembles in its general features those of many of our patients), and the patient began to feel very ill, with a tremulous, dry tongue, but with still a pulse rate of under 100.

June 1.—Thirty-fifth day of disease, bowels began to be relaxed, but general condition to improve.

June 4.—Thirty-eighth day of disease, temperature fell to normal, pulse rate 80 to 88.

June 6.—Fortieth day, at 8.30 A.M., began to have acute pain in lower abdomen, not relieved by any local means. The temperature at this time was 98°, and pulse an hour afterwards 84. There was nothing to be felt in the abdomen, and there was no undue distension. During the day the pain became more severe, the temperature rose to 103°, and the pulse rate to 146, but the respirations

were 24 only. At 8 P.M. Mr Wallace operated. The



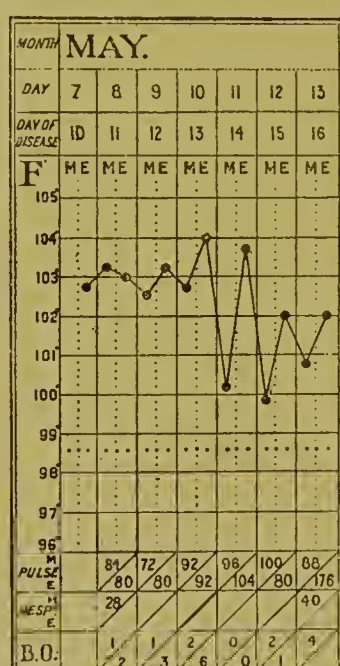
CASE III.—ENTERIC FEVER. PERFORATION. OPERATION.

perforation was found about 6 inches from the valve, and

sewn up. There was severe general peritonitis, with exudation of lymph. The patient expressed himself as feeling free from pain, but died four hours after.

Remarks.—There is no doubt that the operation relieved the pain. The free washing out of the peritoneal cavity probably has something to do with this. It is a matter of regret that the operation was not done sooner, but in this case the pulse rate did not rise so rapidly as might be expected, and pain only is not a sure guide to diagnosis. Possibly the result might have been happier if we could have come to a decision earlier in the day.

CASE IV.—Private G. P., æt. 38, admitted 7th May. Ten days before admission had suffering from diarrhœa and severe frontal headache. On admission he complained of myalgic pains all over the body. The pulse rate was 88, temperature 103°, and respirations 28. The abdomen was not distended. No spots seen. Spleen palpable.



CASE IV.—ENTERIC FEVER. PERFORATION.

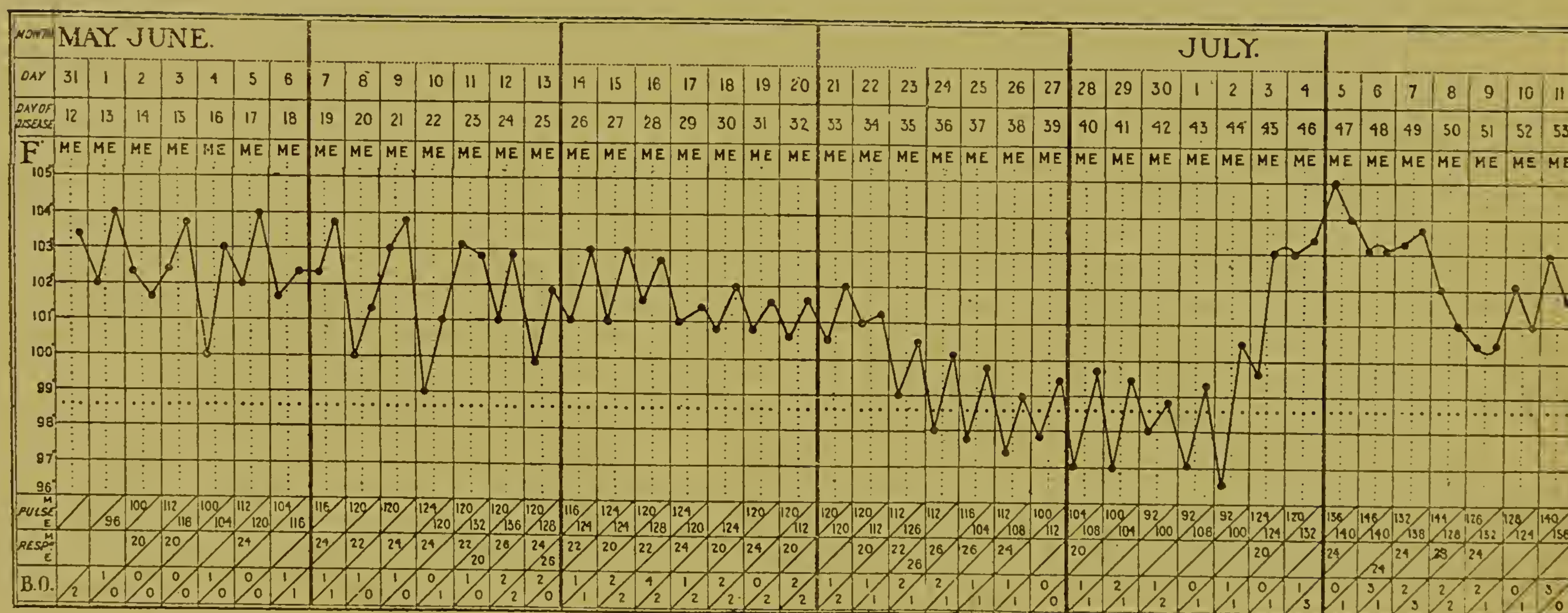
May 13.—At 3 A.M. he began to vomit bile-stained

matter, and vomited four times in the next seven hours, the bowels being relaxed also. Complained of pain in the left iliac region. The pulse rapidly rose from 88 to 176 in a period of three hours, and the respiration rate rose to 40 per minute *pari passu*. Scattered râles were heard over both lungs, and there was some loss of resonance at the right base posteriorly, suggesting consolidation. The abdomen was tender to palpation, particularly in the left iliac region, and was not distended, but, if anything, rather retracted. It also moved slightly on respiration. The hepatic dulness was present, its upper limit the fifth rib in the mammary line. The patient died at 1.30 P.M. on the same day, that is ten and a half hours after the vomiting began, and on the sixteenth day of the disease.

Post-Mortem.—There was found acute general peritonitis, with exudation of lymph, but not much fluid or gas. There was extensive ulceration of the Peyer's patches, one of which had perforated at about 6 inches from the ileocæcal valve.

Remarks.—This case is interesting as illustrating how complete the absence of physical signs of perforation and peritonitis may be, and the difficulties which surround their diagnosis. The appearance of signs in the lungs misled us into thinking that broncho-pneumonia was the complication with which we had to deal. The temperature even gave us no help in diagnosis, and we have to admit that the post-mortem findings were a surprise to us. The only symptoms which could be regarded as pointing to the true state of things were the vomiting and abdominal pain, but the former was a not uncommon symptom among our patients, and the latter was not of such a degree as to suggest so serious a condition as acute peritonitis. The case, however, emphasises the extreme importance of a rapid rise in the pulse and respiration rate.

CASE V.—Private F. S., æt. 26, not inoculated; admitted 31st May; had been suffering from frontal



Case V.—Enteric Fever. Perforation.

headache and "cold in the head" for ten days, and three days before that, some diarrhœa; kept on duty until five days before admission, when the headache became so severe that he had to give up. On admission he was still suffering from headache and cough. Tongue dry and furred at the back. Pulse rate 92, respirations 24, temperature 103.4°. Heart natural. There were scattered rhonchi in the lungs. Abdomen distended; spleen not palpable. Many rose spots. A glance at the Chart will show that this was a long and tedious case; the temperature was subject to rather violent fluctuations, and the pulse was always rapid. The tongue was generally sordid and tremulous, and there was great bodily prostration, necessitating the free use of stimulants.

June 23.—About the thirty-fifth day the temperature began to fall and the pulse to moderate, but the general condition was not much improved.

July 2.—The forty-fourth day the temperature began to rise again, indicating, no doubt, a re-infection.

July 4.—Vomiting began without any definite reason. The abdomen was distended, but moved freely.

July 5.—Temperature 105° in the morning; pulse 136.

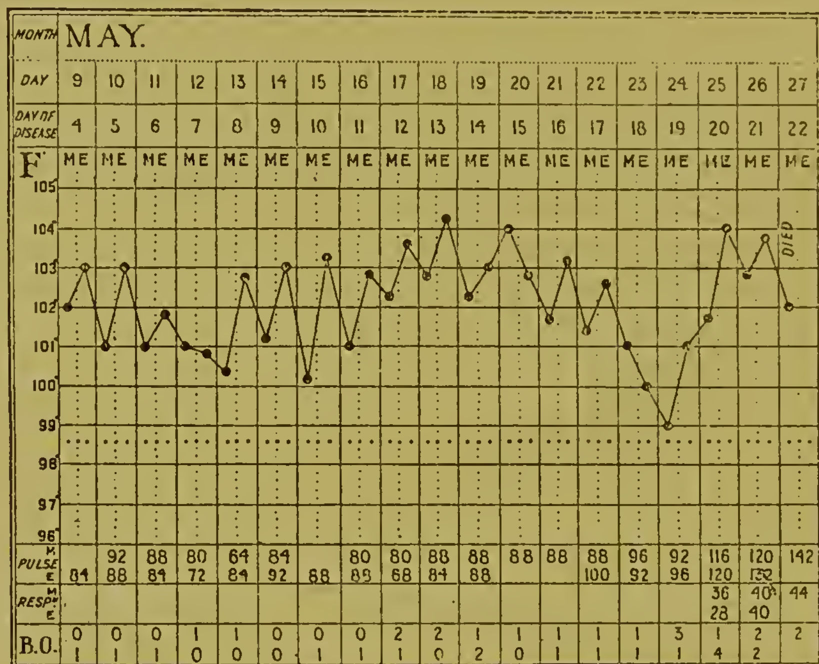
July 14.—The patient became suddenly worse in the morning, the pulse uncountable, and the respirations 60. The Chart is defective here, but the notes give no record of signs pointing to perforation, except some indefinite pain in the abdomen. There was no alteration of hepatic dulness. The patient died at 1.30 P.M.

Post-Mortem.—There was found characteristic ulceration of the Peyer's patches. There was no peritonitis, but a perforation about 18 inches from the ileocæcal valve. This was evidently very recent.

Remarks.—The disease was so malignant in type all through that perforation can scarcely be looked upon as more than a contributory cause of death, especially as no peritonitis was found after death. Here again the

diagnosis of perforation could only be conjectural and surgical interference quite hopeless.

Case VI.—Private F. W., æt. 23, admitted 10th May; not inoculated. He had been suffering for three days with pains in the head and back, no loss of appetite, no diarrhœa. On admission the tongue was furred and moist. Pulse 96, temperature 102°. There was no



Case VI.—Enteric Fever. Perforation of Appendix Vermiformis.

headache, and the patient did not feel particularly ill. Some spots were seen on the abdomen. As will be seen by the Chart the case ran a mild course until the seventeenth day. There was no diarrhœa, and the pulse was usually about 88; but the temperature, which had been falling for about two days before, on the nineteeth day of the disease began to rise steadily, pulse and respiration rate doing the same. At the same time the patient became very ill. The bowels were relaxed, and motions passed involuntarily. The tongue became brown, and he had a griping pain in the abdomen, which, however,

was not distended. On the twenty-first day the pulse rate was 142 in the morning, and the respirations 54. He was much worse, and a purpuric rash appeared over the abdomen and chest. Moist sounds were heard over the left lung posteriorly. He died on the morning of the twenty-first day.

Post-Mortem.—There were found in the base of the right lung some pneumonic patches, probably septic. The peritoneum was generally inflamed, moist, but there was very little lymph. The appendix vermiformis was sodden, swollen, and lying in serous exudation. There was a very small, almost pinpoint perforation in its distal third. On opening it there was found a small ulcer, in the floor of which was the perforation. The Peyer's patches about the valve were roughened and ulcerated, but the ulcers were small and apparently healing. There was also extensive ulceration of the Peyer's patches higher up for about 2 feet.

Remarks.—The diagnosis was here again very obscure. Perforation of the appendix is rare in enteric fever, and it is very doubtful whether such a minute opening would have been found on operation.

Phlebitis in enteric fever has been very common during the latter part of the campaign, much more so than our own figures would lead one to suppose. Seven of our patients developed it in the course of the disease. In all it was in the veins of the left leg, most often the femoral. The average day of its appearance was the thirty-second. In only two of these patients was there any considerable rise of temperature.

From our experience on the ship on the voyage home, when we had charge of the hospital with a number of convalescent enteric cases, we should say that thrombosis was very common, and its resulting œdema also. This was the experience of many other Medical Officers.

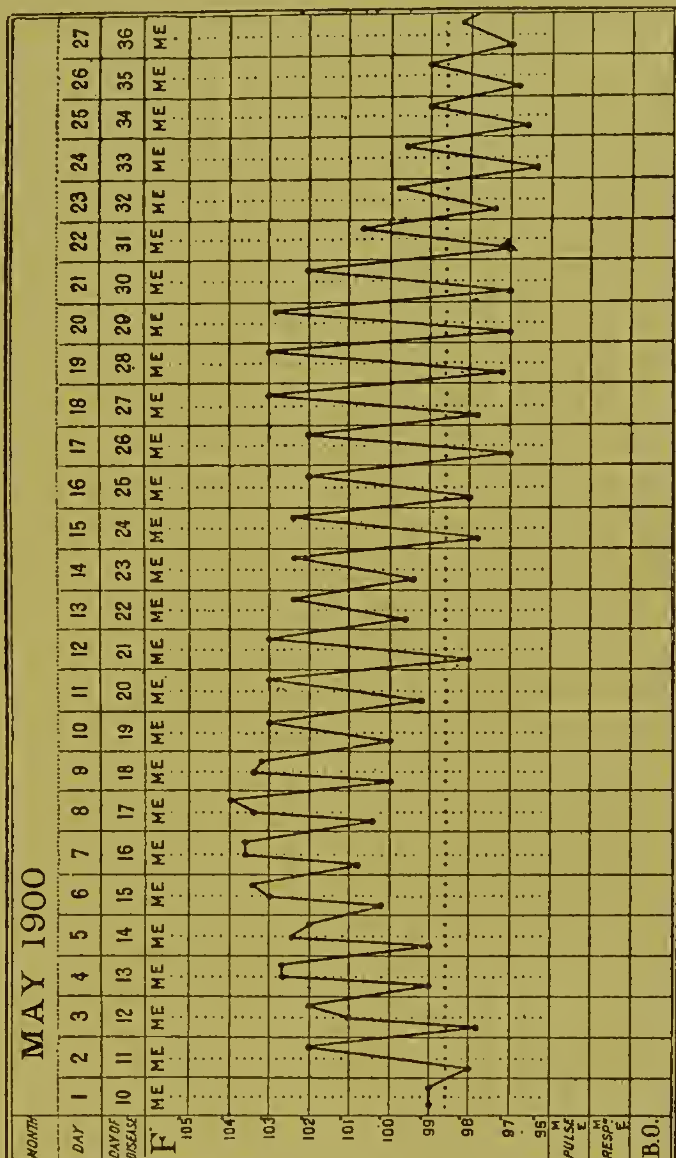
Malaria as a Complication of Enteric Fever.—Malaria has to be reckoned with as a complicating element, because

so many officers and men have served at some time or other in malarious regions, for it cannot be said that malaria exists in the high plateaux of the Orange River and Transvaal Colonies, which were the theatre of war at the time we were out there.

There is no doubt that malarial fever does very considerably modify the course of an attack of enteric fever, so that the term "typho-malaria" has been unnecessarily coined. The diagnosis of the more dangerous disease may indeed be obscured by the occurrence of rigors, with large and confusing oscillations of temperature, but the true state of affairs must sooner or later be revealed by the fact that, in spite of wide differences between night and morning temperatures, the latter never attains the normal. The temperature, moreover, is not under the control of quinine. A puzzling case of this description was the following:—

CASE VII.—A Medical Officer of the R.A.M.C., æt. 43, was admitted on 2nd May. He had served in Egypt and the West Indies, and had repeatedly suffered from malaria. He had been working very hard in the field before admission, and had also been much exposed. For ten days his bowels had been loose, and his afternoon temperature had been raised, 101° F. sometimes. For twenty-one days after admission his evening temperature was between 102° and 104°, and his morning temperature usually about 100°, more or less. Quinine in large doses (20 grains) failed to affect the temperature. For the last six days of his fever the evening temperature gradually fell from 103° to 100°, but the morning temperature was subnormal (hectic type). All fever ceased by the thirty-sixth day of the disease. Meanwhile the bowels were constipated, the tongue furred but moist, and his general condition one of debility without mental dulness. No spots were seen, and the spleen was not enlarged. The blood gave a not very marked Widal reaction, and in it at one time

were found some basic staining bodies, suggesting broken-down plasmodia.



CASE VII.—Enteric Fever in a Malarious Patient.

Morbid Anatomy.—Twenty-nine of our enteric patients died, a mortality of 12.5 per cent. All of these were examined post-mortem except three. In all those examined except two, the characteristic ulceration of the Peyer's patches was found, and in these two there was reason to believe that the patches had been affected. The average day of death was the twenty-seventh. In ten cases

we found no sufficient cause of death,—that is, with the exception of the specific inflammatory lesions of the Peyer's patches we found nothing save perhaps a flabby state of the heart-muscle, and, in some, local collapse of the lung, suggesting broncho-pneumonia. In eight cases there were patches of consolidation in the lung, evidently of septic origin. These patches resembled those seen in pyæmia, varying in size from that of a pea to that of a walnut or larger, even to the involvement of a whole lobe of lung. Such a patch is usually sharply defined from the rest of the lung by a sinuous outline of somewhat lighter colour than that of the patch generally, which is of the dark purple colour, or has the mottled variegated appearance so common in septic infarctions. One of these patches we found gangrenous. In only one case was there a consolidation resembling true lobar pneumonia. In five there was perforation within 18 inches of the ileocæcal valve, but the perforation in one of these was in the vermiform appendix. In all of these there was more or less acute general peritonitis. In three cases there was found extensive ulceration of the large intestine, extending into the rectum in two of them. The ulcers were round or oval, with the long axis transversely disposed; they were shallow with raised edges, and from $\frac{1}{8}$ to 1 inch in diameter. In two of these cases they were mostly in the transverse and descending colon, and in the other mostly about the cæcum and transverse colon. They resembled true dysenteric ulceration, but there was no history of this. These ulcers are not devoid of danger, for they sometimes perforate, as we found in a patient at the Volks Hospital, Bloemfontein. As perforation was evident, the patient was operated upon, and the abdomen opened, when a ruptured ulcer of the ascending colon, about 6 inches from the valve, was found and sewn up, but the patient died nevertheless.

Treatment.

It is so generally accepted that the care of enteric fever

resolves itself into careful nursing, that we are apt to lose sight of the fact that in no disease is the judicious treatment of symptoms as they arise so important, both as regards the comfort of the patient, and the conduct of the case to a successful ending. We are very much of the opinion that tents form most suitable wards for patients with this disease, and that a well-appointed hospital under canvas is much preferable to the utilisation of ordinary houses in a town.

Diet.—Amongst our earliest troubles at Bloemfontein was the difficulty in procuring fresh milk, so that we had to fall back upon preserved milk. We very soon found that the sweetened variety was quite unfit for the purpose. The men had an unconquerable objection to it as a rule, and, moreover, it caused most troublesome vomiting in many. The unsweetened form is much more palatable, and in fact we found that if it were made up out of sight of the patients, most would take it without any complaint. There are several varieties of pure sterilised milk which are as good as the fresh article, but they are bulky and expensive. Condensed milks even when palatable are not really suitable for prolonged use as food, though of great value as makeshifts. This scarcity of fresh milk during the first three or four weeks of our stay at Bloemfontein led us perforce to adopt a somewhat bold method of feeding, but we never saw reason to regret it, and indeed we kept it up even when fresh milk became plentiful. Bread and milk, arrowroot, rice pudding, lightly boiled eggs, custard, beef-tea, soups, and even thin bread and butter were used quite early in the course of the disease, and it was indeed usual to allow a more liberal dietary than authorities have hitherto thought admissible. There are, however, strict limitations to this treatment. Its safety depends entirely upon the digestive powers of the individual patient. The indications that these powers are favourable for a more liberal dietary seem to us to be a moist, not much furred tongue, freedom from diarrhœa and tympanites, and a craving for food. These conditions

obtained in many which were otherwise rather severe cases, judged at least by the thermometer. Bearing in mind the debilitating effects of prolonged high temperature, it seems obvious that the dictum of Graves must apply to enteric as to all continued fevers.

But there is another side of the picture that must be kept sharply in sight. It is now known that the bacilli are not only in the intestines but in every organ of the body. Also that the virulence of the toxin produced, upon which it is supposed the manifestations of the disease largely depend, is greatly enhanced by the presence of other bacteria—bacillus coli, for instance—and no doubt many others. The proliferation of these organisms is favoured in the alimentary canal by imperfectly digested food, with the result that gases of fermentation are produced and local irritation increased. Therefore what might be in a healthy person a slight indigestion, may be, in a patient poisoned by enteric bacilli, the signal for an exacerbation of the disease more severe than the original onset. When the tongue is dry, brown, and cracked, the abdomen distended, the bowels loose, and especially if the stools contain curds of undigested milk, too much care cannot be bestowed upon the dieting, not so much for fear of the mechanical effects of undigested food—and that is a real danger enough—but to prevent, if possible, the conditions which favour the growth of all bacteria in the alimentary canal. In such cases frequent small feeds of milk, peptonised if possible, or diluted with barley water, and not amounting to more than 2 pints in the twenty-four hours at most, should be used. Egg albumen, and various peptone containing preparations are valuable in a campaign when milk is scarce.

Alcohol we used most sparingly, and only in the severe cases in which we feared heart failure, not at all in the milder cases. The small rapid pulse we considered the best indication for its use, and failing this we almost

disregarded high temperatures. We rarely used more than 3 or 4 ounces and never more than 6 ounces in the twenty-four hours. We are very much of the opinion that alcohol is a double-edged tool, and that most patients are better without it. The long-enforced abstinence from all forms of stimulant renders the soldier rather susceptible to its influence as a medicine.

Digitalis and strychnine as cardiac stimulants we used freely, and with, we believe, great benefit. Strychnine in the form of the officinal solution, injected hypodermically, we found very useful, and some patients took large doses, gradually increased even to 30 minims in the twenty-four hours.

Headache was the first symptom that required treatment, and 5 to 10 grains of phenacetin generally afforded speedy relief, or, failing this, antipyrin. In not a few cases this caused during the sleep that followed a profuse perspiration, with perhaps a slight fall in temperature. Beyond the discomfort of this no ill result followed; in fact, in spite of it, the patient generally expressed himself as feeling better. In some cases, however, this sweating was so annoying that it became necessary to add $\frac{1}{100}$ to $\frac{1}{50}$ grain of atropine, and this generally stopped the sweating, but with the discomfort of a dry mouth the next day. If two doses of phenacetin of 5 grains do not give relief, it is unadvisable to give more, and the same remark applies to antipyrin in rather larger doses.

Insomnia was one of the most troublesome symptoms, and a constant cry amongst patients was for hypnotics, which for reasons above given were generally studiously withheld. In many cases phenacetin had the effect of giving sleep as well as relieving the headache; so much so that we frequently used it for that purpose when there was no headache. In obstinate cases we sometimes found bromide of potassium or ammonium of use, with or without chloral hydrate, but the most effectual form of hypnotic was Dover's powder, though we used it very sparingly. Where, however, the patient was delirious and

constantly attempting to get out of bed, we did not hesitate to give hypodermic injections of morphine in large doses, that is ¼ grain repeated two or three times.

Mouth and Tongue.—The care of the mouth and tongue may appear a minor detail, but it is not so in the estimation of the patient. In the severer cases the black, dry, and cracked tongue is more than a discomfort; the pain on taking food may positively interfere with the nutrition of the patient. Local treatment may be all that is necessary, such as mechanical cleansing, or the use of mouth washes, and of these we found one containing chlorate of potash, glycerine, and perchloride of iron, the most useful. A mixture containing chlorate of potash and bicarbonate of soda, taken by the mouth, had a remarkable effect in cleaning and moistening the tongue, so much so that its use became almost a matter of routine.

Intestinal Symptoms.—At first the most common forms of so-called intestinal antiseptics were tried, such as perchloride of mercury, listerine (a proprietary preparation containing eucalyptus and other vegetable antiseptics), etc., but we soon gave up such a routine treatment as futile.

Diarrhœa.—The importance of the treatment of diarrhœa has been commented upon above. We found bismuth carbonate or salicylate, and chlorodyne, a most useful combination for the milder cases; but where this was insufficient it became necessary to supplement it with a suppository of ¼ grain of morphine. If the diarrhœa still continued, a 5 per cent. solution of boracic acid, and sodium bicarbonate 5 per cent., as an enema, often gave great relief.

Constipation is a most favourable indication, and happily very easy to treat, a fairly copious simple enema every other day being all that is necessary.

Tympanites rarely gave us any trouble; it is best treated by boracic injections. A small injection of about 4 ounces of water, containing 2 grains of quinine and

½ ounce of brandy, would often cause the patient to pass flatus with great relief.

Hæmorrhage always yielded to, or after, treatment, which consisted of administering a mixture containing oil of turpentine and tincture of hamamelis, of each ½ drachm, and tincture of digitalis, 3 minims. This was given every two hours, or alternately every hour, with 1 drachm of hazeline. One of us used hazeline every hour, with apparently equally good results. At the same time morphine suppositories, ¼ grain, were used.

Perforation.—The prognosis of this terrible accident is gloomy in the extreme, whether viewed from either a medical or surgical standpoint. We have reason to believe that in a very small percentage of cases the resulting peritonitis may become localised, but this happy event cannot be foreseen, because it seems that the symptoms are rarely, if ever, proportional to the extent of the peritoneal inflammation. The symptoms of peritonitis in the course of enteric fever are not the same in degree as those of the same accident in a comparatively healthy person. The local pain, for instance, is rarely so severe, and may be almost absent, and the patient seldom lies on his back in the characteristic position, with the legs drawn up. Abdominal movement also may be present and ample. The absence of liver dulness as a sign is frequently wanting. But a rise in the rapidity of the pulse and respiration, and a sudden fluctuation of temperature, are almost invariable, and of these the former is the most constant. The diagnosis having been made, the physician has two courses of treatment open to him, both often equally unsatisfactory. The medical treatment amounts to securing absolute rest of the intestines, in the hope of plastic localisation of the inflammation, and this of course is obtained by the free use of opium. If the issue must be fatal, this treatment is humane if nothing else. The surgical treatment is as unsatisfactory as the medical, if, as was often the case, the patient was manifestly

dying from other causes before the perforation occurred, but it is a question whether it is not the duty of the physician to recommend it. It offers a slender chance of recovery, and it is possible that as time goes on this chance may be improved. The history of abdominal surgery warrants this hope. If surgeons had allowed the high mortality in the early days of abdominal operations to deter them from operating repeatedly, that method of treatment would never have attained the position it now holds. It is difficult, however, to imagine a more unfavourable case for operation than a person suffering from enteric fever, especially when the disease is at its height. The operation itself offers no peculiar difficulties, but so bad was each of the two patients who were submitted to operation that we were thankful to get them off the table alive. In Case III., page 92, it is doubtful what time elapsed between the occurrence of the perforation and the performance of the operation; whilst in the only other case in which the operation was performed by one of our own surgeons, the patient was in another hospital, and was not seen until ten hours after the first symptoms pointing to perforation. In both cases the patient expressed himself decidedly as feeling much easier, and in fact quite free from pain at least, but they died four or five hours after. To sum up, then, our opinion is in favour of operation at the very earliest, but the position of affairs should be made clear to the patient if he is in a condition to understand it, and if he refuses operation, the opium treatment should be pushed to the utmost.

"Simple Continued Fever."

Among troops encamped, or even on the march, there appears to be at any time a certain number of sick men in whom fever is the prominent and often the only symptom. These cases are grouped together under the provisional name of "Simple Continued Fever," or "Febricula," and these are convenient terms to use, with

the distinct understanding that they are provisional only, and that they include cases of at present doubtful pathogeny.

Perhaps one of the commonest causes of such a fever is exhaustion. A rise of temperature for a few days may follow an overstraining of the bodily powers—such, for instance, as a forced march. This may be due to the retention within the blood of effete products simply, and may therefore truly deserve the name. Such a fever is usually short-lived, not lasting for more than a week or ten days at the outside.

Arduous and continuous bodily exertion, exposure, and insufficient feeding, together with at the same time the goading excitement of warfare, tend eventually to lower the vitality of some men, and to decrease their resistance to the inroads of various organisms, which, under ordinary circumstances, would be harmless. Some cases of diarrhœa or mild dysentery are accompanied by fever, and sometimes the febrile movement is apparently out of all proportion to the severity of the diarrhœa, so that a simple looseness of the bowels may be overshadowed by a very marked febrile attack. There can be little doubt that both symptoms have a common cause in some pathogenic organism, but that in certain individuals, probably owing to absorption of toxin, the constitutional symptoms are in excess of the local. This point is further discussed under the head of dysentery.

The effects of exposure to the sun are very varied, both in kind and degree, and though the severe cases are fairly characteristic, there are many slighter cases in which continued fever is the only important symptom.

These remarks may seem to be almost truisms, but when the Hospital was at Rondebosch, we undoubtedly received many cases diagnosed as "simple continued fever," but which presented unmistakable histories of diarrhœa or insolation, and we can only assume that continued fever was a striking feature at the front, for they were free from it when they reached us.

In certain localities medical men recognise febrile diseases peculiar to those localities, but of which the pathology is still obscure—such, for instance, as "Kimberley fever" and "Pretoria fever." No doubt in time light will be thrown upon these diseases, as has been the case with the so-called "Mediterranean fever."

Where enteric fever is epidemic there are generally many cases of fever of doubtful identity, and there are Medical Officers who refuse to recognise such cases as other than enteric. Without going so far as that, however, we strongly suspect that many of these so-called "simple continued fever" cases are enteric of a mild type, for it must be obvious that if persons can have an attack of so mild a nature as to be walking about until perforation occurs accidentally—the so-called "ambulant" cases—there must be many degrees of severity between these latter and the severer and unmistakable forms.

There can be no doubt that a large number of cases sent to the base as "simple continued fever" were mild cases of enteric fever.

Dr Dodgson, in the laboratory in the Raadzaal at Bloemfontein, is reported to have found that "75 per cent. of the so-called simple continued fevers which he has examined . . . give the Widal typhoid reaction" (*British Medical Journal*, 8th September 1900, II., p. 757). This coincides with our own impressions. One of our most typical enteric patients at Rondebosch was sent to us as "simple continued fever." It must be assumed that his febrile attack had apparently ceased when he was sent down from the front, and that he had relapsed while on the journey, for he had pyrexia on admission.

The tendency to a remission in the temperature of enteric fever at or about the sixteenth day has been mentioned above (p. 85). This remission indicates, perhaps, the life-history of the microbe, and the toxin saturation point of the individual, and is only one of the problems presented by the great question of immunity.

The remission may be followed by an exacerbation, and the disease thus run its usual long and tedious course, and this suggests a reinfection of the individual. Or the remission may prove permanent, in which case, in the absence of the specific serum test, doubt may exist as to whether the case has been one of enteric fever at all.

In conclusion, then, the diagnosis "simple continued fever" is little more than a confession of ignorance, but it must be tolerated in the absence of more exact knowledge.

It has included in our experience cases of exhaustion only, diarrhœa, or mild dysentery, insolation, and true enteric fever.

The attitude of those Medical Officers who diagnose all cases of continued fever as enteric may not be scientific, but is undoubtedly in the interest of the patient. To diagnose a case as "simple continued fever" suggests at present that the Medical Officer does not know what the fever is, but that he does not think it is enteric, and in the light of our experience we think this a rather dangerous position to assume.

Major Simpson, R.A.M.C., in a most laborious and able report on the prevalence of enteric fever in Pietermaritzburg (Appendix No. VII to Army Medical Report for 1898) shows conclusively that the prevalence of simple continued fevers of all kinds runs *pari passu* with that of enteric fever. No doubt the more general employment of serum diagnosis will tend to diminish the returns of "simple continued fever" as time goes on.

CHAPTER V

DIARRHŒA, DYSENTERY, SUNSTROKE, DISEASES DUE TO EXPOSURE, FUNCTIONAL DISEASES, MENTAL DISTURBANCE

Diarrhœa.

A certain amount of looseness of the bowels was so common as to be almost universally complained of at one time or another. In some cases it was associated with local disturbance of considerable severity, colicky pain and vomiting, and even a temporary rise of temperature. This was most noticeable in men who had but recently arrived from home, and was possibly due in some cases to an unaccustomed diet. In not a few patients this diarrhœa became chronic, especially if it had not been methodically treated at the first onset, so that it was not uncommon to meet men who had suffered in this way for months. The pathogeny of this condition is open to question, and in fact there can be little doubt that there are more causes than one. The soldier is the most careless of mortals in the matter and manner of feeding; it is rare to find, among these patients, a good set of teeth; the food on the march is necessarily not so good as in camp, and some stomachs do not take kindly to tinned meat and biscuit. The food is liable to be contaminated with sand—in fact the men were swallowing sand all day in large quantities, more especially on the march, but also in camp to a greater or less degree. It has been suggested that this gritty matter has a mechanical effect on the

mucous membrane of the intestines, and the term "sand diarrhœa" was frequently used. Without doubting the fact we hesitate to accept the conclusion, and hold to the opinion that it is rather to the infective matter that adheres to the sand that we must look for an explanation of the symptoms than to the actual sand itself. The great diurnal variation of temperature must not be overlooked as a possible factor in this affection. It was not uncommon to experience a difference between the night and day reading of 50° F. in the tents, such as a midday temperature of 80° F., and a fall at night to 30° F., and this difference must have been still greater in the open air. A catarrhal inflammation of the large intestine due to cold is therefore at least a possibility. In the more chronic cases it is not unreasonable to suppose a follicular ulceration of the large intestine readily curable by local means. But in what does such a chronic case differ from the severer dysentery except in degree? We are here again confronted with the question of the reaction of the individual to some common microbic cause.

CASE VIII.—A colonel, aged 55, came under our care with this history. For over a month he had been suffering on and off from attacks of diarrhœa, which had yielded to treatment and diet, only to recur when he resumed his ordinary life. Seven days before admission the diarrhœa had become more severe, fifteen motions a day with some pain and griping. Once or twice there had been a trace of blood in the stools. He had been in India, and had had fever in Malta, but had never actually been on the sick list. On admission he was looking thin and worn, his tongue was furred but moist, pulse 72, soft, and afternoon temperature 101° F. He was treated with hourly drachm doses of magnes. sulphate, which, however, purged him so much that it was stopped after twelve hours. This was followed by bismuth and chlorodyne, and a morphine suppository, with the result that he had only three motions

in the twenty-four hours and less pain. For the next eleven days he had never less than four motions a day, and always a raised night temperature ranging from 100° to 102° F. On the thirteenth day after admission he was given a silver nitrate injection, 5 grains to the pint. This having little effect, was repeated at intervals of four, two, and three days, so that he had four injections in all. This treatment had some effect in controlling the diarrhœa, reducing it to about two motions a day, but with a short relapse two or three days after. All this time the temperature was irregular, with almost always a night rise, but the patient was improving in general health, gaining in weight, appetite was good, and he was able to walk about a little. Finally he was sent down in the hospital train to Wynberg, where he soon quite recovered.

This case is a fairly typical one. Everything that could be done by diet, nursing, and drug treatment, general and local, was done, but it was found necessary eventually to send him to the base. Several important posts required him, but he must have broken down had he undertaken them. He returned in a month, better in health than he had been since coming out.

There were many other officers and men in a similar case. For instance, another officer had had persistent diarrhœa all the time he had been in the country, over three months; at last his temperature began to rise, with so much general feeling of illness, that on admission enteric fever was suspected. However, in a day or two his temperature fell, and ten days after admission he had an attack of jaundice. He was so debilitated that it was necessary to invalid him home. The question of the relation between fever and diarrhœa, already alluded to under the head of "simple continued fever," deserves further notice here.

In most cases colitis is not accompanied by much constitutional disturbance or fever—in fact many severe cases of diarrhœa are marked by a subnormal temperature.

But this is not always so, for a continued fever may exist for many days, and a nocturnal rise and morning fall is not unusual. It is probable that these symptoms indicate a general absorption of toxin, from deficient resisting power on the part of the individual, or, in other words, inadequate phagocytosis. It is therefore obvious, if this be true, that, within certain limits, there is not necessarily any proportion between the degree of inflammation of the bowel and the severity of the constitutional symptoms. It is a matter of clinical observation that a slight but persistent diarrhœa may be accompanied by an unexpected degree of bodily illness, fever, and loss of flesh; whilst a sharp dysenteric attack may produce no more than the discomfort and perhaps pain of repeated defæcation.

In conclusion, one feels justified in adopting the opinion that dysentery is diarrhœa "writ large," or, in other words, that the two have a common origin. The importance of this conclusion is obvious, for, if it be accepted, we must regard every case of diarrhœa with suspicion, not so much on account of possible consequences to the patient himself, as in the case of suspected enteric fever, but for the protection of others. For it is obvious that in this light every case of simple diarrhœa must be looked upon as a possible focus for the further dissemination of the disease, and persons infected from a slight case may develop dysentery in its severest form. Thirty-six cases of diarrhœa were admitted into the wards, many of these, however, convalescent; it is most likely that the great majority deserved to be called dysentery.

Treatment.—This is comparatively simple if taken in hand at once. It was usual with us to begin with a castor oil and opium draught (Ol. ricini 2 drachms, and Tinct. opii 15 minims), and this was often sufficient; but it was usually necessary to follow on with the ordinary aromatic chalk and opium, or bismuth carbonate and chlorodyne. In the severer cases it was necessary to

admit the patient to hospital for a day or two, and keep him on a diet of milk and arrowroot. Some cases yielded with reluctance to treatment, though apparently mild in degree. These required the local treatment of the large intestine described below. A few were so chronic as to need transference to the base, where they often rapidly recovered without any further special treatment.

If the opinions expressed above on the oneness of some diarrhœas with dysentery are correct, it is obvious that as much care should be exercised in the disposal and disinfection of the fæcal evacuations in the one case as in the other. Men should be urged to apply for treatment as early as possible, because there is no disease in which prompt treatment is more likely to be followed by permanent results.

Dysentery.

Dysentery is essentially an inflammation of the mucous membrane of the large intestine, having presumably some specific organism as a cause, by means of which the disease may be communicated by one individual to another, and probably by the same agencies as aid in the propagation of enteric fever. It is as widespread in its geographical distribution as enteric fever and malaria, and as is the case with both these latter diseases, it takes a certain amount of local colouring from the particular climate or region in which it may happen to exist. So that, for instance, we speak of Asiatic, West African, or European dysentery. It is at present not possible to say whether these local forms are but varieties of the same disease having a common pathogenetic origin, or whether they are quite distinct from one another. The dysentery that occurs in England is as a rule sporadic, and in fact the term dysentery has almost dropped out of our nomenclature in ordinary or hospital practice, and is reserved for those cases that have a tropical origin. Cases of intense inflammation and ulceration of the large

intestine occasionally occur, and have received the name "ulcerative colitis," which term is correctly descriptive, but somewhat misleading, and must not be taken as implying that it differs from ordinary dysentery in the matter of communicability. And indeed it is now well known that in asylums full of patients of dirty habits, an ulcerative colitis may, and does, run riot*; and here, as in South Africa, every degree of severity may exist, ranging from slight diarrhœa to a fatal disease. There is so close a similarity between "ulcerative colitis" in England and dysentery in South Africa, that one hesitates to call them by different names. The term "ulcerative colitis" tends to foster a feeling of false security, and it is wiser to recognise the possibility of outbreaks of epidemic dysentery in England, though the disease is not likely to be formidable to the community at large, unless it be made so by overcrowding and all the circumstances implied by the term "bad sanitation."

The type of dysentery experienced by us in South Africa differed from the tropical form in one important particular at least. In tropical dysentery the tendency to secondary hepatitis is very marked, and is shown by tenderness over and enlargement of the liver, and the liability to abscess. This seems to mark an important distinction between tropical dysentery and that form from which our soldiers mostly suffered in South Africa. It is in the experience of most physicians that officers invalided from tropical regions may have attacks of hepatitis for a long time after arriving home, even on apparently slight provocation, such as exposure to cold, or after trifling gastro-intestinal disturbance. We have therefore placed cases of men who have served in India, or with a previous history of tropical dysentery, in a separate category.

Ninety-four cases were under treatment in the Port-

* See Report of Drs. Mott and Durham on "Colitis, or Asylum Dysentery," summarised in *British Medical Journal*, April 6th, 1901, p. 838.

land Hospital from first to last. Of these, seventy-eight had acquired the disease in South Africa, and sixteen had served in India or some other tropical region. Three died, that is a mortality of 3.1 per cent.

Symptoms.—At first the symptoms are those of a severe diarrhœa with many loose motions—three or four an hour. The first stools are the diluted contents of the large intestine, but they soon contain a quantity of mucus and shreds of membranous inflammatory material cast off from the surface of the mucous membrane. Later this mucus will be tinged with blood, or the stool may contain so much blood as to appear to consist wholly of it. It is remarkable how little pain and constitutional disturbance there may be even in a severe case—in fact there may be little to note beyond frequent and annoying purgation and rapid loss of flesh. There is, however, often pain in the abdomen, sometimes indefinite as to situation, sometimes referred to the supra-pubic region, and rather to the left side, suggesting the sigmoid flexure. Not uncommonly very severe pain after stool is referred to the anus, probably due to excoriation about the sphincter. The abdomen is generally rather flattened than full. There is frequently a rise of temperature for the first two or three days, then a small rise at night only; often the temperature is subnormal throughout. This relation of fever to colitis has been discussed above (p. 114). There is always a loss of flesh, often rapid, and proceeding in the fatal cases to extreme emaciation. Even in the most severe cases tenderness or enlargement of the liver was conspicuously absent. In one patient only, of those who had acquired the disease in this campaign, was there any tenderness in the hepatic region, and it is possible that this might have been referable to the colon.

In one of the fatal cases enlargement of the liver was made out before death, and after death the colon showed the characteristic ulceration to be described shortly; this man had served in India, but had not had dysentery there.

PLATE XIX.

Case IX.—Acute General Dysenteric Ulceration of Large Intestine.

[*To face page* 119.

Two other patients suffered from hepatic tenderness, and both of these had had dysentery in India.

The course of the disease was very variable in different cases. Some, apparently very severe, yielded readily to comparatively simple treatment and dieting; others proved extremely obstinate, causing considerable anxiety.

It is probable that the duration of the symptoms depends largely on the presence or absence of actual ulceration of the mucous membrane, and that if the disease be actively treated in its earliest stages, its duration may be much curtailed. If, on the other hand, any considerable area of mucous surface be ulcerated, progress towards convalescence is likely to be proportionately slow. The average duration of the disease from the first diarrhœa to its cessation was twenty-six days; some cases were of so short a duration as five to ten days, and others so long as thirty-five to forty-five days.

The average duration of symptoms after treatment had been commenced was fourteen days, but some yielded to treatment in three to five days. If untreated it seemed that the disease might go on in a chronic fashion, with exacerbations, for months.

CASE IX.—H. S., æt. 20, Private, Bedfordshire Regiment, had been suffering from diarrhœa for about five days before admission, and had been quite well up to that time. The stools contained blood and mucus, he said, and he had been having a good deal of pain in the abdomen, but no tenesmus. The appetite had failed, and he had lost flesh rapidly.

May 31.—On admission, he was generally wasted, and his face had a drawn and anxious look. The tongue was dry and furred, with a tendency to the formation of a central streak. Pulse 124, temperature 101.4° in the evening. The bowels acted about thirty times in the first twenty-four hours—in fact he persisted in keeping the bed-pan under him continually. He was very querulous, and evidently felt very ill.

June 1.—Temperature 99° in the morning, and 99.6° at night. A morphine suppository stopped the diarrhœa for about ten hours, but the patient remained very ill.

June 3.—Two doses of ipecacuanha (20 grains) were given with the usual precautions, and at a twenty-four hours' interval. He was sick twice after the second dose, and the diarrhœa continued, twelve stools in the twenty-four hours, the motions consisting of blood-stained mucus and blackish powdery matter. The temperature was now subnormal, and continued so until the end. The pulse rate for the first five days gradually dropped from 124 to 112, and after that was never more than 96. Magnesium sulphate by the mouth, and boracic injections, and even silver nitrate injections, were tried in succession, with morphine hypodermically, but the patient grew steadily worse, the pulse became uncountable, and he died on 8th June, nine days after admission.

At the autopsy, fourteen hours after death, the body was found to be extremely emaciated, but all the internal organs were healthy except the large intestine. This was acutely inflamed and ulcerated in its whole length. Such mucous membrane as remained was deeply injected and swollen; in the cæcum and the ascending colon it was channelled with ulceration, and in the transverse colon there was scarcely any mucous membrane at all, merely little islets or tags here and there, the ulceration or necrosis extending down to the submucosa, or even to the muscular coats, which lay quite bare in places. The surface of the rectum was also deeply injected, swollen, and extensively ulcerated.

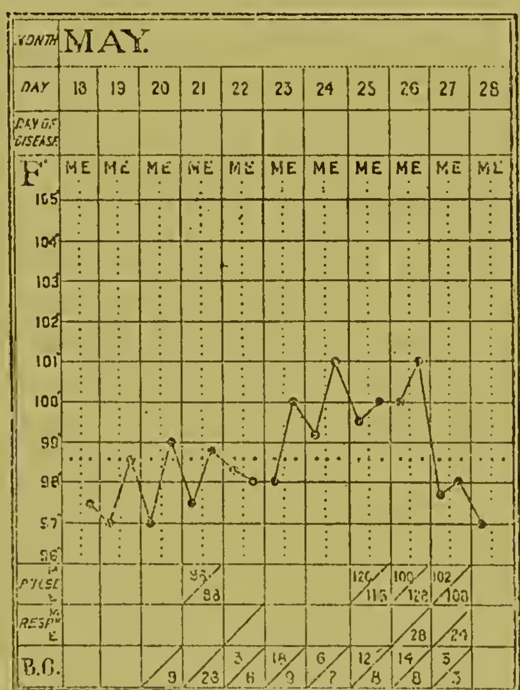
Remarks.—This was an unusually rapid case, only thirteen days from the first symptom. There was comparatively little pain, and the fever was of short duration, that is only for three days after admission, and it was never high. Rapid emaciation and evident suffering were the only indications of the gravity of the illness. The diarrhœa

CASE X.—CÆCUM, showing extensive destruction of Mucous Membrane in Dysentery. [*To face page* 121.

was not so serious as in many of our more favourable cases, and the fatal issue came almost as a surprise.

The post-mortem appearances were those of so-called "general ulcerative colitis."

CASE X.—O. D., Private, 2nd Worcester Regiment, æt. 23. On 2nd May was admitted into the 12th Brigade Field Hospital suffering from severe diarrhœa, with blood and mucus in the motions. He was transferred to the Portland Hospital 18th May, when he was suffering from great debility, colicky pains in the abdomen, diarrhœa, bowels moved ten or more times a day, the stools consist-



CASE X.—DYSENTERY.

ing chiefly of blood-stained mucus. Tongue furred, but moist. Pulse rate 84; temperature 97.4°. The patient had been in India for six years, but had never had dysentery. He was put upon hourly drachm doses of magnesium sulphate. This was followed two days later by an astringent treatment, but there was no improvement.

May 21.—The bowels were open twenty-six times, so a boracic injection was given, followed by a morphine suppository, and this relieved the diarrhœa considerably.

May 27.—Patient getting steadily worse in spite of all treatment. Pulse ranging between 108° and 120°, respirations 24. Vomiting and hiccough; bowels open eighteen times a day. An injection of silver nitrate produced no appreciable effect.

May 28.—Patient died at 2 P.M. of exhaustion.

Post-Mortem.—Body much wasted. Grey hepatisation of the base of the right lung. The mucous membrane of the large intestine showed general inflammation and ulceration, but not so much in the ascending as in the transverse and descending colon and the rectum. Large areas were denuded of mucous membrane. Such mucous membrane as was left was swollen and deeply injected; this was very marked in the rectum. The mesenteric glands were enlarged but not very much so. The liver was larger than normal, but there was no evidence of local inflammation of it.

Morbid Anatomy.—Three of our cases of dysentery proved fatal; post-mortem appearances were practically the same in each. These appearances have been sufficiently described above. They are those of a widely spread and deep ulceration or necrosis of mucous membrane. The ulceration and the general appearance of the large intestine resembles, in every respect, that described and figured by one of us under the name of "General ulcerative colitis." (*Pathological Transactions*, 1894, p. 66.)

The appearances warrant our assuming that in this form of dysentery a general acute inflammation is the first step in the morbid process. It may stop at this, or it may go on to the proliferation of the superficial epithelial cells, which may then be shed off in flakes, thus producing the shreds so common in the stools. The inflammation may be so acute as to give rise to diffuse hæmorrhage, which then stains the mucus, so freely poured out at the same time.

Finally, as a further advance in the morbid process, necrotic ulceration of large tracts of membrane follows, a condition frequently, if not always fatal.

Treatment.—This is as a rule much more satisfactory than it appears to be in the true tropical form, but the ipecacuanha treatment which is so successful in tropical dysentery seems to be much less so in the South African variety. We tried it in several cases with no appreciable result. The course of treatment we followed generally with success was the following. Complete rest in bed, with a diet consisting of milk and arrowroot, and also beaten-up eggs, and in some cases where there was merely exhaustion, port wine. The drug treatment consisted of sulphate of magnesium in drachm doses every hour for thirty-six to forty-eight hours, or even longer. The effect of this in some cases was to increase the number of stools, but to render them more watery with less mucus, and if there was blood in the motions, to cause its disappearance in five or six hours; in others the number of stools was at once sensibly diminished. There was at the same time a lessening of pain and tenesmus. The therapeutic effect of this treatment seems to be that of a washing-out of the large intestine from within. This treatment was followed by bismuth carbonate (15 grains) and chlorodyne (15 minims), with the result that in most patients the dysenteric symptoms almost if not entirely ceased. There were cases, however, in which this result was not so readily attained, and in these it became necessary to resort to local treatment, the most successful being injections of from one to two pints of equal parts of 10 per cent. solutions of boric acid and sodium bicarbonate, passed into the bowel slowly by the irrigator. This was still more effectual if followed by a $\frac{1}{4}$ grain morphine suppository. In a few cases even these methods failed to completely arrest the symptoms, and then injections of silver nitrate (5 grains to the pint) were generally successful. In one case it was necessary to give four of these, but generally two were found to be sufficient. In one the bleeding

persisted in spite of all these methods, but finally yielded to an injection of tincture of hamamelis ½ ounce, and tincture of opium ½ drachm to the half pint of water.

In the fatal cases the diarrhœa and the hæmorrhage were undoubtedly controlled by these means to the comfort of the patient, but they died of asthenia with extreme emaciation, and it is indeed difficult to see how any treatment could be ultimately successful in such a condition of bowel as was revealed by the autopsy.

SUNSTROKE.

Our opportunities of studying this disease were comparatively few, for the Hospital was at Rondebosch during the summer months, and this was too far from the front for patients to arrive in the acute stages, and local cases were not very common. A fair number of patients were sent down as cases of sunstroke, and the disease deserves some notice here. When the Hospital removed to Bloemfontein the weather was so comparatively cool that we saw very few cases there. One of us, however, had the opportunity of seeing cases in the early stages at Modder River in February before the general advance, and the following short description is the outcome of personal observation at the Guards' Hospital, and conversations on the subject with the Guards' Medical Officers.

The work at outposts was at this time very trying, and the heat often intense. The only shelter for the men from the sun was that afforded by the brown service blankets stretched on short posts; under these the men lay with their coats off, and often their chests bare. It is needless to say that a blanket offers a very poor shelter from the heat rays, when in a double-roofed tent they are almost unbearable.

The symptoms generally came on during the night following the exposure, but sometimes quite suddenly while on duty. Intense occipital or frontal headache, with a feeling of stiffness in the neck muscles, and high fever,

105° F., are among the first symptoms. Extreme general debility amounting to a general paresis is almost invariable. This is so marked that, if taken ill while on the march, the patient is quite unable to proceed. The tongue is thickly furred and sometimes dry and brown. There is frequently acute gastric catarrh at the same time. The disease may be ushered in by a convulsion, but delirium is not common. Subjective flashes of light on sitting up in bed are frequently complained of by the patient. The acute symptoms last, with continued high fever, from three to six days, and then begin to subside. The headache is generally more severe in the daytime, and moderates or entirely ceases at night, to come on again when the sun gains power. The debility often remains extreme for days or weeks after the acute symptoms have subsided. There is a tendency to relapse, so that for many weeks the patient is liable to break down again after return to duty; it is, in fact, a question whether such cases should not always be sent to the base.

On their arrival at our Hospital at the base, the most striking feature presented by these patients was the great debility, but most of them still complained of headache, generally posterior, and they showed a marked reluctance to leave the shelter of the ward tents. Exposure to the comparatively mild sunshine of Cape Town seemed to bring on the headache. They resembled in this particular some forms of neurasthenia. A few patients made little improvement and had to be sent home.

Treatment. — Shelter from the sun as complete as possible and in bed is the first essential. Cooling drinks, ice, acetate of ammonium, and a light milk diet, *without stimulants* as a rule, are also necessary. The gastro-enteric symptoms may require special treatment, and the headache is best treated by phenacetin. In the later stages strychnine and quinine are given for the debility with benefit, but in a severe case it is best to send the patient right away to a cooler climate.

Diseases commonly attributed to Exposure.

Among these may be included catarrhal inflammation of bronchi, lungs, and kidneys, and rheumatism. If exposure to cold is a prime factor in these diseases they should have been very common, for large numbers of men, even at Bloemfontein, slept on the ground night after night with no more protection than a blanket shelter, when the thermometer was considerably below the freezing point. It is true the air at these altitudes is comparatively dry, but there was enough moisture to cause a white frost on most nights, and when the rain fell, the ground, being of clay, became unpleasantly sodden, and the drying process was slow. The large daily variation of temperature, at least 50° F., has been already referred to. The very dress of the soldier would appear to favour these diseases, for it is difficult to imagine a more uncomfortable covering than a wet, sodden, cotton drill. And yet in our experience bronchitis was rare. We have notes of only six cases, and of these three were previously subject to the disease. Of true lobar pneumonia we saw not one case.

Even as a complication of enteric these affections were rare, strikingly so, compared with home experience. The common cold in the head was rarely seen. We must, therefore, assume that the micro-organisms which probably play so important a part in these diseases do not flourish on the higher plains of South Africa.

Phthisis was still more uncommon, *i.e.*, two cases only, both apparently acquired on the voyage out.

Acute Nephritis should have been not uncommon if exposure plays an important part in its causation, but we only saw three cases, and in these the kidney lesion was almost certainly not acquired during the campaign.

Rheumatism.—We had under treatment from first to last only fifteen cases, but it was a common diagnosis among patients received into our Hospital convalescent and on their way from the front to the Cape. The commonest

manifestation of this disease seems to consist of pain in the legs without swelling of joints; eleven were of this description. The remaining four had some articular swelling, but without much fever. But of true rheumatic fever we saw no example except one on the ship coming home, and we therefore assume that it was not common.

The pains in the legs, above alluded to, seemed as a rule to be myalgic, often indefinite as to localisation, but evidently very real to the patient. In some cases they were undoubtedly in the line of nerves, sciatic and peroneal, and of the nature of a perineuritis. One of us experienced these pains when at Pretoria, in his own person, and can testify to the crippling nature of them. The movement of walking was sometimes so painful as to cause a decided limp. It is possible that unvaried diet, with a preponderance of the meat element, may have something to do with the development of this complaint, in addition to exposure to cold and wet. Sodium salicylate sometimes, but not by any means always, gave relief. In some distinctly neurasthenic patients there was a constant complaint of similar pains.

In considering the remarkable immunity of soldiers on active service from those diseases commonly attributed to exposure, we must not lose sight of certain important points. The age of the soldier is that in which, after initial risk, exposure in a healthy climate might be expected to have a hardening effect, and consequently a diminishing liability to such diseases. Alcohol is not an article of diet on active service—in fact almost total abstinence was the rule throughout the campaign.

The condition of the soldier after a few weeks' active service compares very favourably with that on the voyage out, when cases of pulmonary disease were quite common, even after so slight exposure as sleeping on deck in warm latitudes. The Medical Officers of the Woodstock Hospital, Cape Town, utilised largely for receiving the

sick from amongst troops newly arrived, would probably have a very different experience from ours.

Heart Disease may be conveniently considered here. In only one case was it likely that the heart affection was acquired on service, and this was in one of the few cases of articular rheumatism. In the other cases the heart lesion probably dated from a previous attack of rheumatism. Naturally one does not expect to find many cases of heart disease among a selected body of men. We had, however, eight cases in all; in these the mitral was the valve diseased, five with regurgitation, and three with stenosis.

Disordered Action of the Heart is very commonly diagnosed, *i.e.*, palpitation and irregularity of action; but when one sees the debilitated and sometimes anæmic condition of some men after hard service, it is only surprising that functional derangement of the heart is not more common.

FUNCTIONAL DISORDERS.

The conditions on active service are eminently favourable to the development of all sorts of functional disorders of the nervous system. This class of case often offers considerable difficulty to the Medical Officer. The indefinite nature of the symptoms gives the malingerer the opportunity for deception that he needs, or, to put it less strongly and perhaps more justly, the unwilling soldier may take advantage of a real but slight basis of disease, and, as this presents symptoms mostly of a subjective kind, he may exaggerate these symptoms to his own benefit and to the confusion of the Medical Officer. The effect of such possibilities on the mind of the Medical Officer is, in turn, to make him regard with suspicion all subjective symptoms which are not supported by more definite signs, and so to run the risk of doing an injustice to his patient.

Neurasthenia.—A review of all the functional nervous disorders arising out of this campaign would probably

be of the greatest interest. Unfortunately it has not been in our power to make comprehensive observations on this class of disease, those falling under our immediate care being comparatively few. The frequent poor state of general nutrition, the excitement of battle often following prolonged mental strain and bodily fatigue, must all combine to favour the appearance of functional nervous symptoms.

We cannot say, however, that there is anything particularly distinctive in the clinical picture of neurasthenia, as we saw it, compared with that of civil life. Among the symptoms we find prominently in the foreground pain, in the form of headache, generally posterior, pains in the neck, pains in the back and limbs, so that these cases are sometimes sent back as cases of rheumatism; general feebleness of the muscular system amounting often to paralysis more or less pronounced. The knee-jerks in these patients are very often of the neurasthenic type, that is, felt up the body and down the legs, described by them as being like a "galvanic shock," often also increased in degree. The plantar reflexes may be diminished or absent, but never accompanied by the "extensor response."

As an example we may mention the case of a private in the Gordons, whose helmet was shot off his head by an unexploded shell. He was not wounded or hurt in any way, but lay on the ground for two hours unable to rise, and was then taken back to the Brigade Field Hospital, from which he was transferred to the base. All this time he had pain on the top of the head and down the back. He gave a history of sunstroke in India, and it is possible that the sun may have been contributory to his condition on this occasion. When he came under our observation he was very feeble, bodily and mentally. He had marked double ptosis, evidently functional, for it soon disappeared, and constant headache. He improved generally, but it became necessary to send him home.

Mental Disorders.—Alienists well recognise that the boundary line between neurasthenia and certifiable mental unsoundness is often ill-defined and easily overstepped. It is not surprising, therefore, that a certain number of cases of mental unsoundness should occur. In fact, considering the extremely harassing nature of the military operations, it is rather remarkable that we did not see more of such cases. Outpost duty in the face of a watchful enemy is of itself sufficiently wearing, especially to officers, but it is still more so when it involves want of sleep, which it usually does. One of us saw a sergeant at Modder River, who was evidently suffering from delusions of persecution, but he was the only one in our experience who was certifiably insane. We, however, heard of at least three officers who committed suicide.

The average private soldier is of a stolid disposition, and up to the present the whole trend of his training has been to remove from him all sense of responsibility, which in other walks of life is one of the prime factors of mental breakdown. We were much struck by the utter absence of imagination, curiosity as to the future, and even recollection of past stirring events in which they had taken part, of many of the men, so that it was very difficult to get a history from them. This may, no doubt, be an acquired symptomatic mental dulness, but usually it is only an indication of a natural stolidity of temperament. As may be expected, the tendency to a disturbance of mental equilibrium was more common among officers who would naturally bear the responsibilities of the campaign in varying degrees. But even among these we came across no case of certifiable unsoundness.

Since our return, however, we have seen many cases of officers complaining of a tendency to emotional outbursts, which have sometimes taken the form of irresistible fits of weeping on the slightest excitement. The following will serve as an example :—

Case XI.—An officer of the R.M.A., æt. 38, had all through the war held a responsible position in the Intelligence Department. About the middle of April, during a march, he became rather suddenly very emotional, bursting into tears in an uncontrollable fashion; at the same time he suffered from giddiness, but without headache. This passed off in a day or two, and he resumed duty. A month later he had another attack like the last, in degree and duration. In June his General sent him back from the front, but he continued on duty. At this time he was emotional again, could not apply himself to work; writing a letter was a great trouble to him; he found himself making mistakes in writing, dropping words here and there, and his writing altered in character, became scrawling, and not so good as formerly. At this time also he was very irritable, sleeping badly, sensitive to noises and strong light, in fact typically neurasthenic. In October, after his return, he was decidedly improving fast, but he still could not go among people because of the tendency to burst into tears. He was then slightly unsteady in walking toe and heel down a line, and with the eyes shut he suddenly fell down. The knee-jerks were not increased, but decidedly neurasthenic in character.

In December he had so much improved that he returned to light duty. The knee-jerks showed the same character as before, but in a less degree.

General Debility.—This somewhat indefinite term includes a number of cases of men obviously unfit for duty, by reason of loss of flesh and general weakness, but without any marked mental or nervous symptoms. There is often distinct anæmia. Many of them suffer from dyspepsia, and bad teeth were very common among them—no doubt a fruitful cause of such malnutrition. The treatment was generally simple and satisfactory; rest and good feeding, iron and strychnine tonic, with proper attention to the digestion, and the result was usually a rapid gain in weight and bodily power.

The following notes on functional disorders following wounds are supplied to us by Mr Bowlby :—

Functional disorders causing contractures and paralysis occurred in a certain number of wounded patients, and in others a highly neurotic, emotional, or even hysterical condition resulted from injuries inflicted on men whose nervous systems were highly strung by the strain of campaigning, the anxieties of outpost duties, and the want of proper sleep, often for many nights in succession. In some cases the exhaustion resulting from lying out wounded, without food, and with the pain and anxiety resulting from a shattered limb, contributed to such conditions, whilst, occasionally, the administration of morphia in large doses and for a considerable time might be held responsible for these results.

The following brief notes of a few cases will better indicate their symptoms :—

An officer was shot at short range near Driefontein by a bullet which shattered his ulna in its middle third and lacerated the ulnar nerve and adjacent muscles. Although not wounded elsewhere, the patient had complete loss of power in the flexor muscles of his upper arm, and this paresis remained for at least two months after the wound had healed, and then only gradually passed away.

The next patient was an officer seen in London in consultation with Mr Howard Marsh and Dr James Taylor. He had been shot through the outer side of the upper arm by a bullet which had evidently injured none of the nerves of the extremity, for its course was limited to the outer side of the arm exclusively, and was nearly subcutaneous. When, however, the bandages were removed a few days after the wound there was a persistent unyielding contracture of all the flexors, causing flexion of fingers, wrist, and forearm, which, like all functional contractures, never relaxed at any time except when the patient was anæsthetised, and even then returned before consciousness was restored. The electrical reaction of all the muscles was

normal, and sensation was unimpaired. It is now several months since the wound, and very gradually during the past few weeks the tonic spasm has yielded, and the arm bids fair to resume its usual functions very shortly. The patient in question is a very robust, hearty man, and free from neurotic tendency of any other kind.

An officer fell on his sacrum whilst scrambling up a kopje under fire, and though not apparently seriously hurt at the time, he had pain in the back next day, and in the course of three weeks became gradually paraplegic. We saw him five weeks after the injury in one of the base hospitals. He then had almost complete paralysis of the lower extremities, but the bladder and rectum were quite unaffected, and sensation also was normal. There was no pain, and the limbs exhibited no rigidity or increase of reflexes. The patient was much depressed, and believed himself to be permanently paralysed. We assured him he would get quite well, and suggested massage and galvanism, with the result that improvement was so rapid that in a fortnight he could walk about the ward, and was improving daily.

A private was shot through the thigh, and had symptoms of contusion of the sciatic nerve. He had but little evident muscular wasting, and no complete anæsthesia, but complained of constant pain, and was consequently kept more or less under the influence of morphia. On account of the intolerable nature of the pain, the surgeon under whose charge he was cut down on the sciatic nerve at the seat of the wound, and divided some scar tissue that seemed to compress it, but the operation gave no relief. We saw the man in one of the base hospitals, and advised stopping the morphia, and the use of gentle massage and passive movements, with the result that the patient became almost intractable from his pain, and morphia was again resorted to. After a time it was once more stopped, with the same result, and finally the man had a violent hysterical fit, after recovery from which there was complete and permanent cessation of all pain.

A patient near to whom a shell had exploded without causing evident injury became quite deaf and dumb forthwith. He remained for weeks in this condition, but we were told that when on board ship on the way to England he woke up one morning to find he had completely recovered both speech and hearing.

THE SURGICAL WORK

By ANTHONY BOWLBY, F.R.C.S.,

AND

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CHAPTER VI

WEAPONS AND PROJECTILES

Description of Rifles and Projectiles. — The change from the old large bore rifle, firing a hardened lead bullet propelled by black powder, to the modern small calibre magazine rifle, firing a mantled bullet with smokeless powder, has taken place since the last great war. The effect of such a rifle on the casualty list has been, therefore, up to the present date, a matter of conjecture. It was foretold, as it has been with every improvement in rifles, that a great increase would take place in the number of wounded and killed. As usual, this prophecy has turned out to be false, and we find that the proportion of killed and wounded, and of killed to wounded, has remained much the same as in former wars, though of course a final statement on this subject cannot be made until the full returns for this war have been published.

The chief points in which the modern rifle differs from the old are decreased calibre, increased velocity, the shape and construction of the bullet, the addition of a magazine, and the use of smokeless powder.

These alterations mean, from a military point of view, an increase in the number of rounds carried, increased range, increased rapidity of fire, a very flat trajectory, and therefore an increased "danger zone."

The trajectory of a bullet is the curved line of its flight, and the highest point of this line at long ranges rises considerably above the height of a man. The

danger zone for a particular range is the distance measured from the point at which in its flight the bullet will hit a man to the spot where the bullet reaches the ground. The flatter the trajectory, the longer will be that part of its flight in which it can do damage.

All European armies are now armed with rifles whose calibres vary from .315″ in the Austrian Mannlicher to .256″ in the Roumanian Mannlicher. The calibre of our own arm has been reduced from .450″ in the Martini to .303″ in the Lee-Enfield. The highest sighting is in the Lee-Metford, namely 2800 yards, and the lowest is in the 8 mm. Krag-Jorgensen, where it is 2078 yards.

Practically, however, all modern rifles carry much beyond the distance to which they are sighted, and the Lee-Enfield is effective at 3500 yards.

The increase in the velocity necessitated an increase in the pitch of the rifling, and in order to enable the bullet to receive the proper spin from the grooves, it was covered with a hard mantle made of steel or various copper alloys. As the rigid mantle prevents the bullet expanding on ignition of the powder, the projectile is made of slightly larger calibre than the rifle, so that the maximum diameter of the Lee-Enfield bullet is .311″, though the calibre of the rifle is only .303″. The accompanying table shows the different characteristics of the modern rifles used in this war, and also those of the old British arm, the Martini-Henry. This last is furnished because it was used frequently in the campaign, and shows the points in which the old and new arms differ.

The commonest weapon among the Boers was the Mauser. The calibre of this particular weapon was .275″ or 7 mm., and it is sighted to 2000 metres. The rifle is loaded by drawing back the bolt, slipping the "charger," holding five cartridges, vertically into a groove, and then pressing the cartridges into the magazine. The charger is

DETAILS OF RIFLES.

	LEE-METFORD.	LEE-ENFIELD.	MAUSER.	MANNLICHER.	MANNLICHER.	KRAG-JORGENSEN.	GUEDES.*	MARTINI.
Calibre	·303″	·303″	·275″	·315″	·256″	·256″	·315″	·45″
Rifling—No. of Grooves	7	5	4	4	4	4	4	7
Rifling—Pitch	1 turn in 10″ To the left.	1 turn in 10″ To the left.	1 turn in 8·66″ To the right.	1 turn in 9·3″ To the right.	1 turn in 7·87″ To the right.	1 turn in 8″ To the left.	1 turn in 9·85″ To the right.	1 turn in 22″ To the right.
Sighted to	2800 yds.	2800 yds.	2187 yds.	2460 yds.	2296 yds.	2400 yds.	2000 yds.	1450 yds.
Weight of Cartridge	416 grs.	416 grs.	384 grs.	455 grs.	350 grs.	371 grs.	443 grs.	758 grs.
Weight of Bullet	215 grs.	215 grs.	175 grs.	244 grs.	165 grs.	156 grs.	230 grs.	480 grs.
Length of Bullet	1·25″	1·25″	1·19″	1·25″	1·23″	1·25″	1·25″	1·25″
Calibre	·311 max.″	·311 max.″	·280″	·322″	·263″	·260″	·315″	·450″
Charge	30 grs. Cordite.	30 grs. Cordite.	40 grs. Nitro-powder.	42 grs. Nitro-powder.	36 grs. Nitro-powder.	36 grs. Nitro-powder.	30 grs. Nitro-powder.	85 grs. Black powder.
Nature of Mantle	Cupro-nickel alloy.	Cupro-nickel alloy.	Steel plated with cupro-nickel.	Steel.	Steel plated with cupro-nickel.	Steel plated with cupro-nickel.	Steel.	None.
Mnzzle Velocity	2000 foot-seconds.	2000 foot-seconds.	2262 foot-seconds.	2034 foot-seconds.	2395 foot-seconds.	2309 foot-seconds.	1900 foot-seconds.	1300 foot-seconds.

* The details of this rifle are approximate only.

thrown away. The magazine is practically always in use as the rifle has no "cut off," and is not convenient as a single loader.

The rifle our troops were armed with was the Lee-Metford Mark II, and the Lee-Enfield. These rifles differ in a few points. The calibre is the same, but in the latter the rifling has only 5 grooves to the 7 in the former, and the grooves are slightly deeper in the Lee-Enfield. The number of cartridges held in the magazine has been increased from eight to ten, and a safety bolt has been provided.

The weight of the Lee-Metford is 9 lb. 4 oz., and that of the Mauser (.275″ bore) which we possess is 9 lb. 4 oz. Comparing the British arm with the standard Mauser of the Boers, we find that the calibre of the Lee-Enfield is the larger, .303″ to Mauser .275″. The muzzle velocity is less, 2000 foot seconds to 2262 foot seconds.

The weight of the British projectile is greater, 215 grains to 175 grains. The mantle of the Lee-Metford bullet is made of an alloy containing 80 per cent. copper and 20 per cent. nickel, while the Mauser mantle is composed of steel covered by a thin coating of an alloy of copper, by the aid of which the bullet takes its spin from the rifling. The mantle in nearly all forms of modern bullet is made thicker at the apex, and this is the case in both the Mauser and Lee-Metford bullets.

The core of each bullet is made of hardened lead which is seen exposed in the centre of the base of the bullet, the outer part of the base being formed by a turning over of the mantle.

The shape of the head of each bullet is of the "ogival" type, *i.e.*, the head is formed by arcs of circles whose radii are equal to multiples of the diameter of the base.

The magazine of the Lee-Enfield has to be loaded by pressing each cartridge in separately, while the Mauser magazine is filled much more rapidly by means of the charger. Against this must be placed the fact that our

magazine holds 10 cartridges to the 5 of the Mauser, and that our rifle can be used as a single loader by means of the "cut off," although the magazine is also available if more rapid fire is essential.

Surgical Aspects of Modern Rifle Fire.

It may be useful to consider how the alterations from the old to the new rifle has affected the surgical side of the question.

Size of Bullet.—The decrease in the calibre has been in favour of the wounded. Not only is the destruction of the tissue along the track of the bullet less than with the Martini, but the apertures in the skin are much smaller, and although this is not of any great moment as far as the actual wound is concerned, it has a very decided effect in diminishing the risk of sepsis. The amount of discharge from a small-bore bullet wound is also appreciably less than from one caused by the old large-bore bullet, thus aiding rapid scabbing of the wound and consequent sealing off from the air. Another way in which the small bore is a gain to the individual wounded is the rarity with which any extraneous matter, such as fragments of clothes, are carried into the body.

The amount of shock, both local and general, is less than formerly. A Martini bullet, if it struck the shoulder of a man, would generally spin him round or knock him over, but the modern bullet would most likely pass through without producing anything like this effect.

Weight of Bullet.—The decrease in calibre has produced a great decrease in weight, as the length of the bullet remains much about what it was, for there is but little difference in the Martini and Lee-Enfield in this respect.

This again is in favour of the wounded. Indeed the stopping effect of a bullet depends a great deal on the area of the body hit, so that within limits a bullet of large cross section produces a greater effect than a bullet of the same weight but smaller sectional area. The "setting up"

bullet has been devised to remedy the comparatively small stopping power of the small bore bullet by converting some of its length into breadth, and thus bringing it up to the sectional area of the old bullet. This effect is quite apart from the rending effect of such distorted projectiles.

Velocity of Bullet.—Increased velocity does compensate mathematically for loss of weight, according to the formula $E = \frac{1}{2} M V^2$,* but the soft parts of the human body offer so little resistance that the bullet cannot exert its full energy on them. It can be said, then, that as regards the "stopping" effect the increased velocity has not compensated for loss of sectional area. In the case of dense bone, however, the bullet is enabled to part with some of its energy, and so does great damage. In the soft tissues of the brain also its effect may be far-reaching, and due to the same cause which produces disruption of leaden vessels filled with water when perforated by the high velocity bullet.

It must be remembered, however, that wounds in the zone of extreme velocity have been rare, and we may yet have something to learn in this respect.

Rotation of Bullet.—This, in so far as it tends to keep the bullet true in its flight, will enable it to enter the body point first, and thus make but a small external wound. This spin must enable it to perforate the tissues cleanly, but most probably it is not a very important factor either for good or bad. The velocity of flight is lost more quickly than that of rotation, so that towards the end of its flight a bullet will, relative to the distance traversed, rotate more rapidly. It can at the most only make one complete turn during its passage through the tissues in any antero-posterior wound, as its greatest speed of rotation is one revolution in 9 inches.

Increased Rapidity of Fire.—As far as the surgeon is concerned this will only affect the number of wounded, but whether in the direction of increase or decrease has yet to be proved.

* E = Energy. M = Mass. V = Velocity.

Increased Range.—This has not much effect on the actual number of men wounded, although men are wounded at greater distances. Firing commences sooner, and battles are fought with the combatants farther apart. The actual range at which a man is hit is, of course, important in so far as the velocity of the projectile is great or little.

Flattened Trajectory means an increased "danger zone," and therefore more wounded, and will only affect the nature of the wounds in so far that with a low flight of the bullet the body in the prone position may be penetrated from above down, or *vice versa*, more often than with the higher trajectory of the old pattern rifles.

Shape of Bullet.—This is made so as to offer the least resistance to the air, and will therefore be also better suited to penetrate the body than the old forms.

The Casing of the Bullet. — The hard mantle has rendered alteration or distortion within the body less common, and so has led to infrequent retention in the body of irregular fragments. The modern bullet is so resistant that it can smash the densest bone in fragments and then pass out through such a small opening as to make it tolerably certain that the bullet was practically unaltered. When speaking of the bullets something more will be said on this subject, but it was rare for a perfect bullet uninjured by ricochet to disintegrate in the body.

As to ricochet deformities producing bad wounds by means of a partial separation of mantle and core, it is very improbable that such a wound ever equals in severity that caused by a perfect Martini bullet.

Alterations in the Shape of the "Perfect" Military Bullet.

Ricochet and Fragmentation.—Although the number of wounds caused by ricochet bullets is insignificant com-

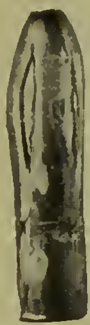
pared to those caused by direct shots, the subject has some points of interest.

Bullets are of course subject to alteration either outside or inside the body. In the former case the alterations are due to the bullet striking the ground, and in the latter to its impact on bone.

The deformities due to ricochet are very numerous, and depend on the consistence of the object struck and the angle of impact.

Perhaps the commonest deformity was a longitudinal scoring, the bullet glancing off the hard ground or rock. If the projectile was travelling fairly parallel with the object struck, the groove or grooves would run nearly the whole length of the bullet, and exhibit a slightly spiral arrangement due to the twist on the projectile. The groove might be quite shallow, but was sometimes so deep that it gave the idea that the bullet had been actually twisted on its long axis. At other times, instead of being grooved the bullet became flattened from side to side (Plate XXI.), and assumed such a breadth that the mantle cracked and exposed the core in varying extent on its flattened surface. Bullets that passed through ant-heaps assumed this shape. If the rent in the mantle was big enough, the core escaped and formed a distorted plaque of lead (Plate XXI.), which was not uncommonly found on the battlefield.

In addition to the longitudinal deformations which left the length of the bullet practically unaltered, there were those that actually shortened it by a bending on the long axis. There were in this series all sorts of varieties ranging from a slight flattening of the apex to a very pronounced bending of the front part of the bullet. This bending, when well marked, was usually accompanied by considerable flattening, and produced a shape which called to mind a rather turned-up, square-toed slipper (Plate XXI*a*.). Such an alteration was, as a rule, produced without any rupture of the mantle, and was caused by a rather more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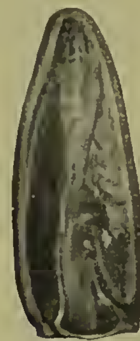
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1. A Jeffreys bullet which passed through the abdomen of a man, and is just beginning to expand.
2. Partially set-up or expanded core of a Mauser bullet.
3. A Mauser bullet flattened by ricochet, showing splitting of mantle.
4. Portions of two distorted Mauser mantles.
5. Core of a Mauser bullet flattened by ricochet.
6. A Lee-Metford bullet extracted from knee-joint, showing longitudinal scoring and grooving.
7. A Mauser bullet which had entered the axilla base first, and shows no marks of rifling.

[*To face page* 144.


8.


9.


10.


11.


12.


13.

8. A Mauser bullet, showing shelling-off of nickel plating at the base.
9. A "slipper-shaped" Mauser bullet.
10. A Mauser bullet, showing spiral grooving from impact on bone.
11. A Mauser mantle which has split; portions of the torn metal have rolled up.
12. and 13. Lee-Metford bullets, showing rifling grooves of different depths.

[*To face page* 144.

direct impact on the ground than that which gave rise to the longitudinal scoring already mentioned.

When the angle of impact on the ground more nearly approached a right angle, the tendency was for the bullet to flatten in the direction of its long axis, or to "mushroom," as it is called, and the consequent shortening of the envelope led to its rupture, the sides tearing up into curved strips, which even extended to the base (Plate XXI.). The core under these circumstances parted company with the mantle, and continued its flight with its basal portion often unaltered, but with varying degrees of setting up in its anterior part. This was a comparatively common form in which the core was extracted from the human body. More rarely the mushrooming was continued until the lead was converted into a round disc, often bearing the mark of its original base in the centre, although no such deformed bullet was extracted by us from the body. In addition to the deformities above described, the Mauser is sometimes disintegrated on hard rock into small fragments, and one officer we treated was peppered in several places by such fragments.

We believe that within the body the solid, perfect Mauser or Lee-Metford bullet is unaltered by soft parts and is not liable to much alteration by bone, and that this alteration consists most often of longitudinal grooving or of bending of the nose into the slipper shape above described. It might be objected that it was impossible to say in any individual case whether this alteration occurred in the body or from ricochet, but the fact that the entrance wounds were typical, and that the grooving was smooth and showed no such scoring as that due to ricochet, seemed to indicate in such cases that the alteration in the bullet was the work of the bone and not of the ground. Plate XXI*a*., Fig. 10, shows such a bullet which perforated the tibia without a solution of continuity, and then fractured the thigh of a soldier who was crouching by a comrade and tying up his wound.

Plate XXII. shows the foot and leg of a Highlander who was shot from the front while lying down. The bullet struck the tibia very obliquely, and ran down its surface and emerged by the inside of the instep. The tibia was tender from periostitis, but unfractured. The bullet was of the typical slipper shape, and the flattened surface quite smooth and polished ; it showed no signs of scoring, as if it had ricochetted, and in our opinion owed its altered shape to its impact on the shin.

In many X-ray pictures numerous small shadows of what appeared to be fragments of bullet were seen, although the exit wound gave no reason to suppose that the bullet was in any way altered. It is true that these shadows may in many instances be due to small flakes of bone, but it is possible that some may be the result of the bullet leaving behind small flakes of metal derived from the copper nickel alloy that covers the steel of the mantle, and which is much cut into by the rifling. Bullets that have been extracted often show areas from which the plating is absent (Plate XXI*a.*, Fig. 8).

Many of the bullets in the Mauser cartridges were smeared over with a parafin wax lubricant, which, acting on the copper in the alloy of the mantle or cartridge case, became green from formation of a copper salt. This led to the erroneous idea that the Boers were using poisoned bullets. Needless to say, any bullet leaving the muzzle of a rifle is absolutely cleared of any such material which may have covered it.

There is not much difference in the liability to disintegration between the Mauser bullet and the Lee-Metford, but the former with its steel case is perhaps more likely to fly into pieces and rupture its mantle than is the Lee-Metford projectile which, with its softer coat, is more easily moulded.

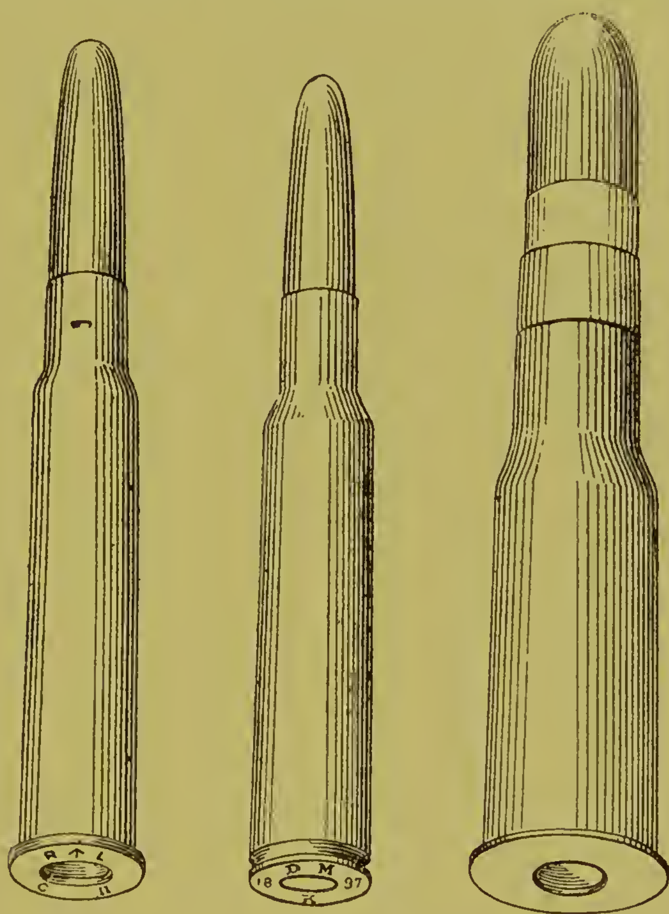
Varieties of Bullets used.—As can be seen, on reference to pages 139 and 149, many different bullets were used by the Boer forces. This partly resulted from the admix-

MAUSER WOUNDS; the aperture of entrance is on the Shin, and the large and oval exit aperture is due to the oblique passage of the bullet.

[*To face page* 146.

ture of different nationalities in the numerous foreign legions, and from the fact that many Boers fought with the weapon to which they were most accustomed.

The characteristics of the different "perfect" or military bullets need no further description, but many of the bullets were of the "sporting" variety, and need some explanation.



1. 2. 3.

1. Lee-Metford Cartridge.
2. Mauser (.275) Cartridge.
3. Martini-Henry Cartridge.

"Soft-Nosed" and "Sporting Bullets."

Soft-nosed bullets of the following varieties were used by the Boers:—Mauser .275", and .315" bore; Mannlicher .315"; Lee-Metford .303". The amount of the leaden core

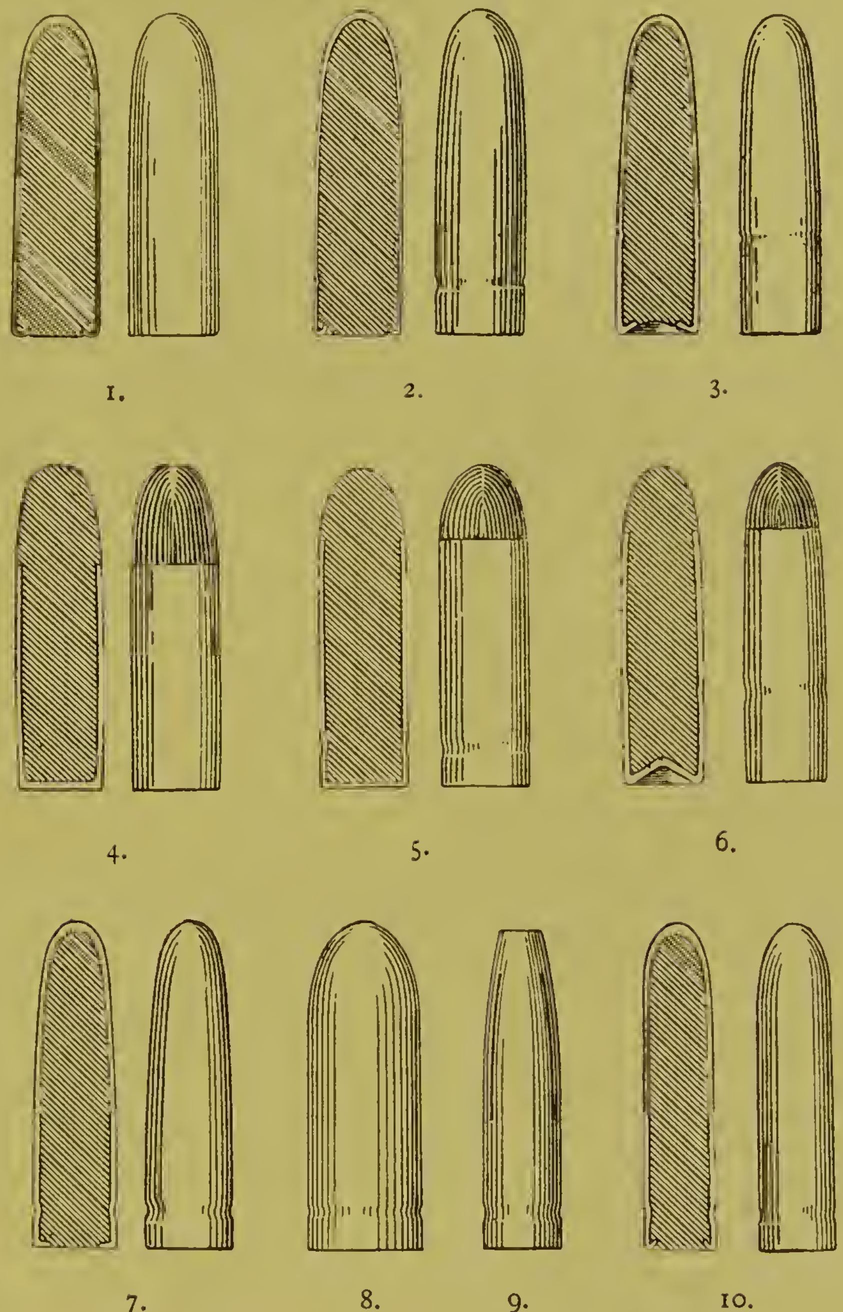
exposed varied in these from about a fourth to a sixth of the length of the bullet. The commonest form by far was that of the .275″ Mauser, with the smaller amount of core exposed (page 149). Another form used was that in which the point of the "perfect" bullet was cut off at right angles to the long axis, leaving the lead core just visible at the apex. A further elaboration of this form is that known as the "Jeffreys" bullet, in which, in addition to the truncation of the bullet, the mantle on the shoulder is nearly cut through by four vertical slits, which, however, do not reach the point (page 149). This particular form of bullet was found both in the Mauser and Lee-Metford ammunition of the Boers. The above varieties are especially manufactured for sporting purposes, and further differ from the perfect military bullets in the fact that the mantle is carried entirely over the base of the bullet to give greater solidity to the projectile.

The Boers also altered the bullets in an amateur way themselves. They filed or rubbed the top of the ordinary Mauser mantle until they exposed the core, or in some cases they cut a ring in the lead of the soft-nosed variety just where it joins the mantle. The Martini bullet was also altered by cutting two grooves at right angles on the apex.

Besides the bullets enumerated above, all sorts of ammunition were found in magazines, or given up by the enemy. What was actually used it is difficult to say, but that many different kinds of ammunition with large bore leaden bullets were used admits of no doubt, and among these, the calibre of which rose to .750″, were some "express" cartridges carrying leaden projectiles with copper plugs in the apex. The shells of these were actually found in Boer positions towards the east of the Free State.

The object of an "expansile" bullet is that it should on impact become irregular and of large calibre, thus inflicting a much more severe and lacerated wound than

PROFILES AND SECTIONS OF DIFFERENT RIFLE BULLETS OBTAINED FROM BOER SOURCES.



1. Guedes, .315. 2. Mauser, .315. 3. Mauser, .275.
4. Mannlicher, .315, soft nosed; almost a third of core exposed.
5. Mauser, .315, soft nosed; almost a fourth of core exposed.
6. Mauser, .275, soft nosed; about a fifth of core exposed.
7. Lee-Metford, .303. 8. Martini, .450.
9. Jeffreys Split Bullet, .303. 10. Mannlicher, .256.

Notice that the soft-nosed bullets have the mantle carried completely over the base.

does the solid projectile. The enlargement in the soft-nosed variety results, first, from the mushrooming of the exposed lead core, when the size of the wound produced will depend on the amount of lead exposed, or secondly, from the tearing open and disruption of the mantle itself, the total disintegration of the bullet being more or less prevented by carrying the mantle completely over the base as already mentioned. It will thus be seen that a bullet with only a sixth of its core exposed need not be a very formidable projectile, for so small an amount of lead cannot spread much. The sporting bullet which has the lead just exposed at the tip, or the elaboration of this form, namely, the Jeffreys bullet, depends for its stopping power on the tearing-down of the mantle and the setting-up of the core. The mantle in this case opens out like the petals of a fuchsia, the strips of metal curling up on themselves at the same time as they fly out from the centre. Plate XXI., Fig. 1, shows one of these just beginning to open out, the splitting being most advanced on the shoulder; the whole bullet has become somewhat shorter.

Sportsmen seem to consider that the soft-nosed bullet with a large amount of lead exposed is the deadliest variety, and say that the Jeffreys bullet disintegrates too quickly and entirely, thus losing penetrating power. Animals, however, have of course a harder covering than the human being, and the results of this war seem to show that the expansile bullet is not so dangerous as would be thought, so far as the soft tissues are concerned, and putting very close range out of the question.

This conclusion is arrived at from the number of practically unaltered sporting bullets which have lodged and been extracted, which means, of course, also, that such a bullet was well-nigh spent. There is, however, other evidence. All the "explosive" wounds that came under our own personal care were injuries involving bone, and this has been, we believe, the experience of others. When

bone is struck the bullet spreads, and by this means is enabled to impart a great deal of its energy to the bone fragments, and these in their onward flight act as projectiles themselves and tear and lacerate the tissues in the neighbourhood. The fragmentation of the bullet is sometimes in such cases extensive, to judge by the particles met with in the wounds (Plate XXI., Fig. 4). At other times no fragments at all are found.

This war has not furnished much opportunity to study the effect of bullets at very close range, and it is possible that a too kindly view has been taken of their behaviour, but at present our own feeling in the matter is, that if a "perfect" bullet hits a man's bone it does all that is necessary to stop that individual fighting for a considerable time, and that if a "sporting" bullet hits a man in the soft parts it is most probable that it will not "set up," while if it hits bone its effects are much more brutal than the necessities of war demand.

CHAPTER VII

BULLET WOUNDS IN GENERAL

Wounds and their Treatment considered in General.—When the small size of the Mauser bullet, its extreme range, and its comparative novelty in warfare are considered, it is not surprising that some difference of opinion as to its effects should exist.

At one time it seems that almost any part of the body can be perforated with impunity, and the observer is inclined to agree with those who name the Mauser a humane bullet, but before such a case is out of mind another is seen, which goes far to prove that those who hold the contrary opinion are right after all.

Take, for instance, the two following cases:—

A Mauser bullet entered the left supra scapular fossa, and penetrating the whole length of the thorax and abdomen, emerged just below the left groin, entered the trousers pocket of the soldier, where it broke his pipe and lodged. The worst pain was that caused by the blow that destroyed the pipe. Both wounds healed, and, beyond a little stiffness in the lower part of the abdomen, there were no other symptoms.

A trooper in the Victorian Mounted Rifles was shot through the lower third of the thigh. The bullet entered behind, and passing forward, shattered the femur, blew out a considerable portion of the length of the shaft, splintered its entire length, and passed out through an aperture that measured two inches in each diameter, carry-

ing with it, or forcing into the surrounding tissue, innumerable pieces of bone and bone dust.

Take again a transverse wound of the thigh, such as was frequently met with in men who had lain on the veld under a cross fire. In one case the wound would be healed under the field dressing in a week, and the man able to get about and look forward to another spell of active service. In another case, the bullet had either touched or badly injured the sciatic nerve, and the patient had some weeks of severe pain before he could in any sense be said to be convalescing.

Again, some wonderful recoveries have taken place after wounds of the head, and patients with these coming down to the base hospitals in the early days of the war, gave rise to the idea that Mauser wounds of the head might be counted among the lesser evils, and it was not till some time later that the true character of head wounds began to appear.

The same tale may be told of abdominal wounds, and for the same reason. Only those that recovered were seen by the people who were in a position to write about such wounds. They told of the abdomen perforated in all its dimensions and in all directions, of recoveries without any, or with very slight, symptoms, or else after some more or less tedious illness. They did not tell of the cases that died on the field, or within a short period of the battle.

To such an extent was this gospel of the innocuous nature of bullet wounds preached, that the tendency in the middle period of the war was to leave to nature cases that were really best submitted to operation.

Shock.—The sensations produced by a wound varied curiously. The commonest statement was, that it felt like the sting of a wasp or an insect; at other times it was likened to a burning sensation, a prick, a knock with a stick or stone, or sometimes to a tremendous blow. The amount of pain differed extremely.

The sensation, whatever it was, was usually located in

the right spot, but some interesting examples of referred pain were noted. One Highlander fancied himself hit in the foot, and at once sat down and proceeded to take off his boot with the intention of applying the first field dressing. His surprise was great when, on taking off his sock, he found no wound, and it was not until he had replaced his boot and felt the blood running down that he discovered that he was shot through the upper part of the thigh.

Another similar case was that of a gunner who was hit in the back of the chest with a shrapnel bullet, but felt the pain in the front of his thorax.

Shock may be local or general, but there seems to be no very definite or invariable relation between the part of the body struck and the amount of general shock produced. One patient who was admitted to the Portland Hospital was shot at 10 paces through the left sterno-clavicular articulation with a Lee-Metford rifle, the bullet passing out through the scapula. He stood still for a couple of minutes, and then sat down to be dressed; he never felt faint. Other patients shot through the chest have been knocked over, rendered unconscious, or experienced such constitutional disturbance as to make walking impossible.

Bullet wounds of the abdomen have varied in the same way, and the patients often exhibited little shock though dangerously wounded. This only corresponds with what is seen in civil practice in cases of ruptured viscera.

In the case of head wounds the same may be said as in wounds of the abdomen and wounds of the thorax. Many men have been killed outright, others rendered unconscious for days, while some with what appeared equally severe injuries did not lose their senses at all.

With shell wounds the amount of shock depended more directly on the extent and nature of the wound, and the amount of the body injured or torn away.

There is something, however, quite apart from the

extent of injury which influences shock. Men who have been hard-worked, lived hard, become tired out with constant watching and little sleep, are much more prone to shock than those who have lived better.

Then there is the personal equation to be considered, the temperament of the man, and how responsibility affects him.

One patient was wounded quite superficially by spluttering bullets on the abdomen, hand, and thigh. All wounds were in themselves quite insignificant, but the man's nerve was absolutely and completely gone, and was not recovered for months. He was wounded in a surprise attack on a hill which commanded the water supply of the camp, and was therefore of great importance, and no doubt this had a great deal to do with the amount of shock produced. The success or otherwise of the engagement in which the wound was received has also its effect. Those wounded in victory are more cheerful and respond to treatment better than those whom defeat has depressed and rendered despondent. As a rule men who have fought successful actions are keener to get back again than those whose efforts have been less blessed.

On the other hand, under the influence of excitement, men have gone on fighting when severely wounded. Sometimes when a man has been hit in two places by two bullets, the wounds being so placed as to quite exclude the causation of the injury by one missile, he will declare that he was only hit once, or that he only discovered one wound when another placed him *hors de combat.*

The Nature of Bullet Wounds.

A bullet wound is essentially a "penetrating" or "perforating" wound, but it must be clearly understood that it differs most materially from penetrating wounds inflicted by sharp-pointed instruments, such as knives or trocars.

This difference is due chiefly to the velocity of the projectile and in a lesser degree to its bluntness, the

consequence of these conditions being that all bullet wounds partake of the nature of contusions, and that, as a corollary, the tissues are liable to be injured beyond the immediate track of the bullet to varying distances.

The evidence that the tissues are injured beyond the track of the bullet is supplied by an examination of any wounded part as well as by the symptoms and results of many wounds. Thus, the skin around the apertures of entrance and exit may be seen to slough beyond the immediate margin of the bullet track; the scar left in the track of a bullet is a dense, firm cord such as would never be caused by a mere puncture, and indicates a proportionate destruction of tissue; nerves may be partly or completely paralysed for a time though not wounded, and vessels that have not been opened by the projectile may afterwards become aneurysmal. All these phenomena show clearly that the effect of the passage of a bullet is not limited to the tissue exposed by its transit.

It is, in the next place, a matter of observation that these widely-spread effects are largely in proportion to the velocity of the projectile, and this may be observed in two very dissimilar constituent tissues. Thus, in the brain the passage of a bullet at a close range may result in a disintegration of almost all of the cerebral mass, so that a true so-called "explosive" effect is produced; whilst at extreme ranges the injury is much more limited, so that a certain proportion of patients wounded by bullets which have lost much of their velocity make satisfactory recoveries after being shot through the brain, and some few of them have but slight symptoms of brain injury.

In bone wounds also the effect of high velocity at short range is to produce very extensive and widespread splintering and pulverisation, whilst at long range and with greatly diminished velocity cancellous bone may be simply perforated, and compact bone fractured with but little comminution.

It may therefore be concluded that in all bullet wounds there is contusion beyond the area of the wound itself, and that the extent of this contusion varies with the velocity of the projectile and the nature of the injured tissue.

One theory that has been propounded to account for this is the so-called "hydro-dynamic" theory, by which the diffusion of the injury is accounted for by the displacement of fluid in the tissue cells and the transmission of a wave effect through the neighbouring parts, and it is quite possible that this may be the true explanation of the results seen in some brain wounds.

On the other hand, in the more dense tissues it would seem that the contusion of them is due to the fact that they cannot part quickly enough to make way for the rapidly travelling projectile, which consequently crushes its way through them instead of dividing or parting them asunder, as would a sharper or more slowly travelling instrument.

But be the explanation what it may, it is of much practical importance to recognise that in all bullet wounds there is always contusion of tissues beyond the immediate area of injury.

The Incidence of Wounds in different Parts of the Body.—This varies with the particular kind of fighting in which the wound was received.

In fights in which men advance in the erect position over open ground to attack an entrenched enemy it naturally follows that wounds of the body and lower extremities will be common.

This was what happened at Belmont. On the other hand, at the battle of Modder River, our troops lay out on the veld finding what cover they could for the whole day, and the position of their wounds differed accordingly, being common in the head and upper extremity, which were the most exposed parts.

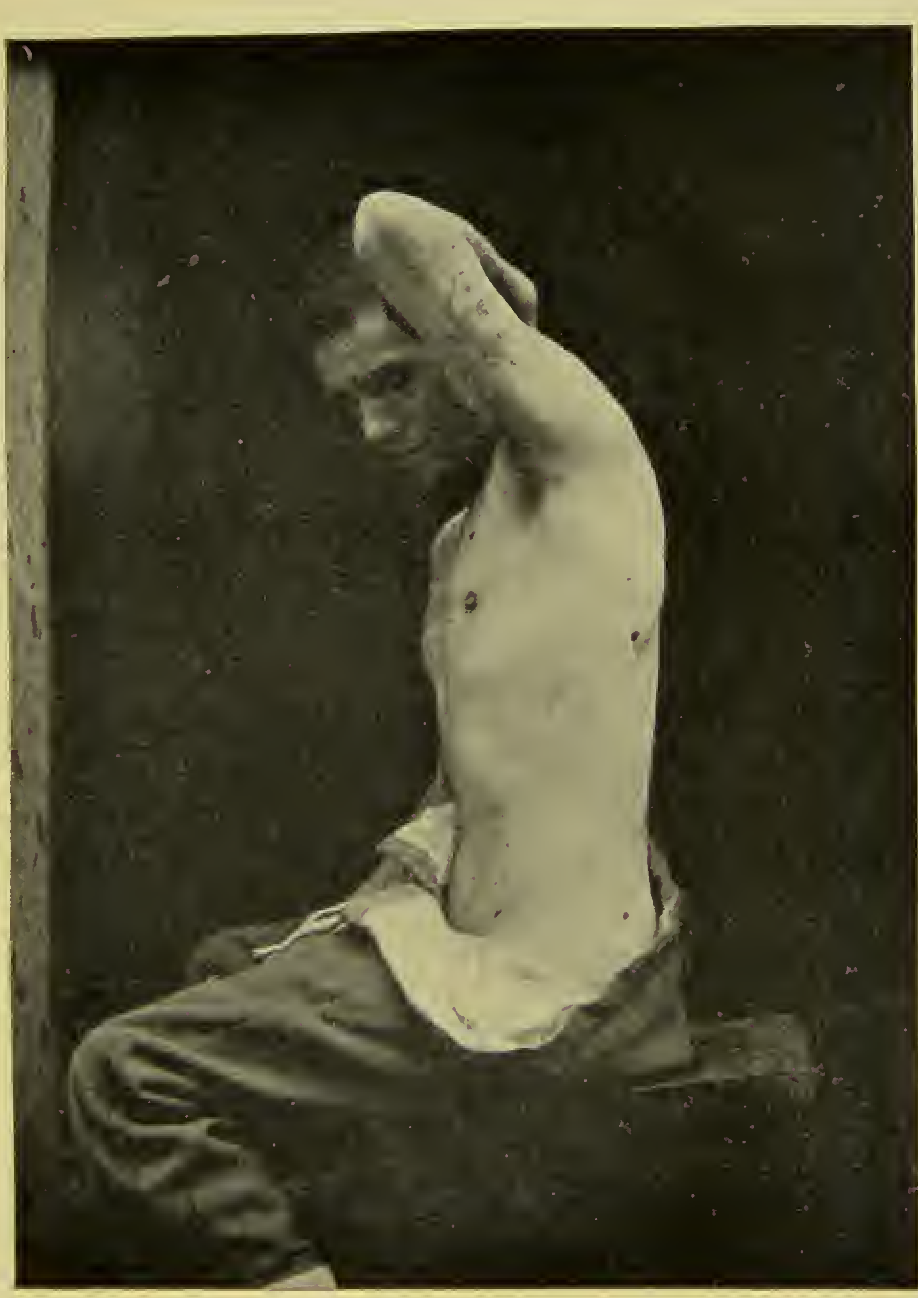
The prone position has also another effect on the

wounds, as it changes their direction in the body, if not also in the head, for the head would be most liable to be hit when the man raised it above the ant-heaps or stone sangars, and would therefore still be liable to wounds in an antero-posterior direction. Suppose, however, that the soldier lay still behind some cover, and the enemy was firing from a kopje, as was often the case, his head and neck would very likely be well covered, but his buttocks, thighs, and legs would be open to the fire, and the wounds would be more or less longitudinal. This has been the case over and over again, and it throws some light on the use that was made of cavalry as mounted infantry, to say that many arrived at the Portland Hospital shot through the thighs and buttocks in this way.

The feet are also wounded frequently when men are lying down taking cover. This arises from the fact that while firing the legs are often spread asunder, and thus deprived of the friendly shade of the ant-heap, and on one occasion a single bullet traversed both feet of one man and one foot of his nearest comrade.

Entrance and Exit Wounds. Different Kinds of Bullets.

Typical Wounds caused by Normal Small-Bore Bullets.— A perfect, undeformed, small-bore bullet entering at right angles to the surface makes, as a rule, a round hole slightly smaller than the bullet itself. Around this aperture is a narrow ring about $\frac{1}{16}$ of an inch in breadth, from which the cuticle has been removed, and which appears some hours after the receipt of the injury as a red border to the wound. A little later this ring, as well as the actual hole, is covered with a dark scab, which consequently is larger than the hole which it covers. The bullet in its passage inwards pushes in front of it the skin, which is thus brought into contact with the sides of the bullet and bruised by it. The projectile then passing on, stretches and perforates the skin, and gains admission through a hole which is smaller



Recent Mauser Wounds of Chest and Hip, showing size of Scab.

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than the diameter of the projectile when the skin is at rest. The actual size of the entrance aperture was found to vary somewhat, and this was attributed to the different calibre of the rifles used by the Boers.

The aperture of exit cannot be so truly said to have a typical shape. It is often round, and presents much the same character at the aperture of entrance, and is about the same size or a little larger. The circular aperture of exit is most often met with when the skin is supported by contact with another portion of the body, as occurs in wounds involving the arm and thorax, or the two thighs.

When the skin is unsupported much variation is found, and the aperture may become a simple slit. This is most frequently seen when the bullet emerges in or near a crease of the body, when the long axis will correspond to the long axis of the body fold. At other times the aperture is crescentic, the bullet pushing out a minute flap of skin in front of it, or again, the skin is sometimes slit in a radiate manner.

Though more constant than the aperture of exit, the entrance wound may also partake of the slit-like character, and it seems that the question of the shape of both apertures depends greatly on the tension of the skin at the point struck and on the support the skin derives from the structures in contact with it, whether they are external or internal to it. The perforations in the clothes show much the same varieties. The entrance and exit wounds are often identical, and appear in the drill or serge clothes much more like tears than punched-out holes ; in fact when the torn fibres are smoothed down there is very often little, if any, loss of substance. This is the explanation of the rarity with which any fragments of clothing have been found in the body.

The tunic of one soldier who had been shot through the anterior axillary fold and then through the upper arm by the same bullet was of interest. Both entrance holes in the tunic were small round holes, and both exit

holes considerably bigger and the edges much more frayed.

Atypical Wounds caused by Normal Small-Bore Bullets. —When the axis of flight of the bullet is inclined at less than a right angle to the surface, the wound in the skin becomes oval, and the breach of surface therefore is slightly bigger. When the angle is very oblique the bullet traverses a certain track of skin, depressing it more and more until actual perforation takes place. The skin, therefore, is bruised and the cuticle destroyed for some distance from the aperture of entrance. This damaged area of skin shows as a red, raw place when the wound is recent.

The shape of this contused area is roughly that of an isosceles triangle with a rounded apex, and the sides are slightly bent outwards. The base is formed by the perforation in the skin. The breadth is often more than that of the actual bullet.

Bullets passing *out* through the skin obliquely make an oval aperture of exit, and this, if the line of flight is greatly inclined to the skin, is often of large size, but still remains oval. The skin is evidently pushed out and then burst. The width of such a wound is rather striking, and is due to the skin being unsupported, and to the natural elasticity of the cutis causing retraction and gaping. It has been thought by some that such wounds are due to the setting up of expanding bullets, but the evidence does not confirm this, for in multiple wounds caused by the same bullet the second aperture of entrance is often quite round and small, although the first exit wound is large and slit obliquely. Some of these oblique wounds have measured 1″ by ½″ and even more (Plate XXIV.).

When a bullet traverses the surface of the skin so as to make a long graze it causes a surprisingly wide area of damage. This appears at first as a red area from which the cuticle has been removed, as described in speaking of oblique penetrating wounds, and the width is often two or three times greater than the diameter of the bullet. The

AN ATYPICAL MAUSER EXIT WOUND, showing extensive splitting of the Skin. The entrance aperture was typical.

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SCORING OF THE SKIN BY A MAUSER BULLET; the upper wound is the aperture of entrance.

[*To face page* 161.

whole skin over the damaged area is extremely likely to slough, and the resulting ulcer is curiously resistant to treatment. So extensive may the sloughing be, that it sometimes seems hard to believe that such wounds could be produced by the insignificant small-bore bullet. Any doubt on the subject is, however, set at rest by the following case:—

A soldier (Plate XXV.) was shot while lying down. The bullet came from the front and perforated the skin over the spine of the right scapula; then emerged, leaving a bridge of skin a third of an inch wide, and travelled down the surface of the body for four inches. The resulting slough was the same length, and at least $\frac{3}{4}$ inch broad at its widest place; from here it gradually tapered off. When the slough separated, the surface refused to granulate, and was not healed at the end of a month from the receipt of the injury.

The extent of such skin wounds may be taken as an indication that in penetrating wounds also, the contusion of the tissues reaches some distance from the actual bullet track, for one actually sees, in skin grazes on the surface, the wide area of damage which is hidden in a perforating wound.

On the other hand it must be remembered that the skin, when injured by the bullet, may stretch and gape, just as in the case of a simple incision, especially when the axis of the wound crosses the skin at right angles to the line of its normal tension.

Track of Normal Bullets in the Body.—The track of a bullet runs, as a rule, straight between the apertures of entrance and exit, the body being in the same position as when it received the wound. If the posture is altered, then the skin may shift, especially if it has been dragged on by clothes; and the muscles, by their action or by returning to the position of rest, may render the track devious.

The actual shape of the track will depend on the

resistance offered by the tissues, as well as by their nature and the amount of support afforded them by the surrounding structures. Cancellous bone is cleanly and neatly drilled, dense bone rarely drilled, but more often splintered; arteries appear as if a piece had been bitten out of the circumference; muscles and fasciæ more often slit and torn than punched out. The inner surface of the track is lined with devitalised tissue, but the extent of this, and how far the effect of the bullet spreads in soft structures, is always difficult to prove. There is always more or less bleeding, and when the track lies close under the skin, some idea can be formed of the extent of the blood extravasation, which then shows up as a bruise in the course of a few days, and extends for a considerable distance on either side.

The amount of scarring in the tissues is sometimes considerable, and bullet tracks can often be traced through muscle as hard, fibrous, pencil-like cords, which are said by some to be most obvious after suppuration has occurred.

Ricochet Bullet Wounds.—In these cases the wounds lose more or less of their typical character, according to the amount and kind of distortion the bullet has undergone. The round, oval, or slit-like wound becomes irregular, torn or jagged, for, even if not greatly distorted after striking the ground, the bullet no longer continues to have its long axis in the line of flight, and so may strike the body with its side, or partly with its side and base. In such cases the length of the wound will vary according to the actual position of the projectile at the moment of its impinging on the skin.

If the bullet has become flattened from side to side and enters point first, the aperture of entrance will be a long oval corresponding to the shape of bullet.

The merely twisted or grooved bullet sometimes resulting from a ricochet makes an aperture which cannot be distinguished from that caused by the normal projectile.

A Ragged Entrance Wound, caused by a Mauser bullet driving in fragments of stone. The man when wounded was in the prone position.

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When, however, the impact on the rocks, ant-heaps, or veld has torn an opening in the mantle and caused it to strip, the wounds become very various in shape according to the amount of separation of the core and envelope, for the mantle when split rolls back in narrow ribbons, which, having sharp cutting edges, inflict a comparatively large and ragged wound.

Then another influence is that exerted by the setting up of the core exposed by the separation of the mantle If this is mushroomed by the ricochet it will cause a wound of corresponding size. It was not uncommon to extract pieces of bullet formed of the core alone, either fairly normal in shape or mushroomed partially or totally, while at other times no trace of the core would be found, but only the distorted mantle or portions of it. When bullets strike rocks at more or less of a right angle they are apt to splutter and fly into many small fragments, and these flying on, cause multiple small jagged wounds, and then frequently remain embedded.

Splinters of the bullet, however, are not the only missiles to produce wounds in such cases. Fragments of rock torn off by the bullet are accountable for some, and this occurred with some frequency when men were fighting behind sangars or lying on rocks.

F. H., Corporal, West Riding Regiment, was wounded at Paardeberg on 18th February. He was lying down under a cross fire. The bullet entered just by the left anterior superior spine, and caused a lacerated wound $1\frac{1}{2}''$ long. The clothes over the entrance aperture were also torn to a like extent. When the patient was dressed another wound was found just over the femoral artery, but of small extent and slit like. On 10th March the wound near the anterior superior spine was granulating healthily, and the slit over the femoral artery was healed. A hard core could be felt to join the two. The X-ray picture showed a bullet lying with its point towards the symphysis pubis under the groin wound. The bullet was found lying

under the skin in the midst of gritty pultaceous material within a fibrous capsule. It was slightly flattened and grazed. The nickel plating was chipped off on one side at the base. (See Plate XXVI.)

The explanation of this case seems to have been that the bullet hit the ground and the body almost at the same time, thus causing a large aperture of entrance, and then passing in, it bruised the skin against the ground, and finally lodged.

There was no sign of a second bullet which could have caused the second wound.

Influence of Range.—Putting aside the nervous system, we do not think that the range, or what is the same, the velocity, has any easily appreciable effect when soft parts alone are wounded, for the bullet finds its way too readily through such structures to give up much of its energy.

When, on the other hand, bone is struck, and a great resistance is offered to the onward passage of the projectile, the velocity becomes an important factor, and the higher the velocity the greater is the damage and splintering done to the bone. At what range this splintering ceases is difficult to determine, but we have seen a radius and ulna fractured in the upper third, with great comminution and splintering, at a range which was over 1000 yards.

The "initial velocity" of modern bullets is so rapidly lost that it is halved between 600 and 800 yards from the rifle, and the "muzzle energy" is similarly diminished at a distance of between 300 and 400 yards (Nimier and Laval).

There is some evidence to show that the brain and spinal cord suffer more from commotion or vibration set up by a high velocity bullet than from one travelling at a lower speed, and this is what would be expected when the soft consistence of such tissues are borne in mind.

Retained Bullets.—The number of bullets that were found lodged in the body was at first rather a matter of

surprise, but even a modern projectile at last loses its velocity, and there was of course no good reason for considering that fewer bullets would be found lodged under modern conditions, when firing commences at a long range, than under the old conditions when combatants reserved their fire until at closer quarters.

All sorts of bullets have been found retained in the body, and so have all sorts of deformed fragments either of core or mantle, but the wounds, as far as our experience went, healed as kindly as though the bullet had not lodged.

In such cases, when cut down upon, it was found that the bullet was surrounded by a thick, fibrous capsule, which in some cases closely and accurately fitted the projectile, the latter being really encysted, and not likely to cause any further trouble as far as healing was concerned.

In other cases operated on at earlier date, the fibrous capsule was found as before, but within was serum, either clear or slightly bloodstained, in which the bullet lay.

At a still earlier date, the bullet was found either lying directly in contact with the wounded tissues, or else surrounded by blood-clot or fluid blood.

In one case that came under our care a bullet had passed in through the buttock, and was located by the X-rays as lodged by its apex in the ilium close to the hip joint. Some time was allowed to elapse, but as walking continued painful, it was decided to extract it. When found, the bullet (a Mauser) was buried for about a quarter of its length in the rim of the acetabulum, and so tightly grasped that it took the whole strength of the operator after the projectile was seized with lion forceps to extract it. This is certainly interesting as showing how cleanly and without fissuring a bullet may perforate a bone.

Theoretically a modern bullet, at the end of its flight, when its velocity is low, would be as easily deflected from its course as the old bullet. That this is a fact was

illustrated in a case under our care where the bullet (a Mauser) had entered the calf by a typical aperture, showing that its course was at right angles to the surface, but was nevertheless found lodged behind the tibia and lying with its long axis vertical, the resistance offered by the bone having been apparently sufficient to alter its course and bring it to a standstill.

A certain number of lodged bullets were found when extracted to be lying inverted, with their apex towards the aperture of entrance, which was usually of the typical form, though contact with bone could in many instances be excluded. The explanation must be sought outside the body, and is due to one of two causes. In some cases it is the result of a ricochet, and this is well illustrated by the X-ray picture at page 194, which depicts a bullet which entered the right knee-joint base first after having passed through the left thigh; the bullet itself is shown on Plate XXI., Fig. 6, and demonstrates well the marking caused by striking a stone or rock.

In another class of case the turning over of the bullet is due to the wearing away of the grooves of the rifling by frequent firing, and in the bullet shown in Plate XXI., Fig. 7, this was probably the cause of the projectile having entered the arm base first, for the projectile was quite smooth, and showed only the barest trace of the rifling upon its surface. It is the rapid twist of a long bullet that alone prevents it from turning head over heels soon after it leaves the rifle, and, if the spin imparted to the bullet be not sufficient, it will soon commence to turn over on a transverse axis, and thus may actually enter the body base first.

"Explosive" Wounds.

(Plates XXXVII. and XXXVIII.) These wounds are practically always met with in connection with fractures of bone, and will be dealt with under that head, but it will be convenient to say a little about them here.

Bullet which has entered the Axilla Base first.

[*To face page* 166.

PLATE XXVIII.

LARGE OVAL WOUND, caused by oblique passage of a Mauser bullet through the Skin.

[To face page 167.

There is no hard and fast line to be drawn between an ordinary typical Mauser wound and those that have been termed " explosive," and all gradations are met with between the small round puncture of the former and the yawning opening of the latter. The wound shown in Plate XXVII. is a case in point. It will be seen that this aperture of exit is large and irregular. The entrance wound is not shown, but was a perfectly typical one. There was no evidence to show that the bullet was anything else but a perfect small calibre bullet, and there was no sign of any fracture of bone. It may have been a setting-up bullet, but as we have said elsewhere, the evidence goes to show that these bullets do not do great harm at ordinary ranges, and this wound was not received at close quarters. The bullet here emerged at an acute angle, and to this we are disposed to attribute the character of the wound.

The extent of the exit wound, it must be borne in mind, has no invariable definite relation to the underlying damage, although it may afford valuable indications thereof. The introduction of a finger will often show that although the exit aperture may be large, the skin is so undermined and the muscles so torn that a still larger irregular cavity is formed into which the ends of the fractured bone protrude, and this was especially well shown in cases of fractured femur (Plate XXXVI.).

Another form of wound is that in which the skin is blown away to a great extent. This is likely to happen if the bullet emerges from a subcutaneous bone, as the shin, and then there is a definite loss of substance, so that a crater-like wound results. (See Plate XXXVII.)

A third form is that in which the muscles and tendons are torn and at the same time extruded through the skin wound, and form a protruding mass above the level of the skin resembling in some degree a fungating sarcoma, especially if seen for the first time some days after the infliction of the wound. (See Plate XXXVIII.)

Shell Wounds.—These have not the interest that

pertain to the injuries caused by the small-bore bullet, since the effect of shell fire is well known, and has presented no striking novel results as far as wounds are concerned.

The projectiles used in this war may be said to consist of three varieties, namely, shrapnel, segment, and shells charged with a high explosive.

Shrapnel shells are usually made to weigh 12 or 15 lbs., and consist of (1) a hollow body or case measuring about 7 or 8 inches in height and about 3 inches in diameter, which is filled with about 200 round bullets, the number varying according to the size of the shell; (2) a "head" of complex structure comprising a fuse and explosive charge, designed so as to blow off the head of the shell in mid-air and thus to scatter the bullets.

In the case of Shrapnel the wounds may be caused by the whole shell, or, after it has exploded, by its constituent parts, such as the case, the head or fuse, the leaden bullets, or such missiles as the driving band and portions of metal used in the interior of the shell.

The Segment shell is made up of a series of cast-iron rings, having projections from the inner circumference arranged radially, and forming, as it were, the outer part of spokes of a wheel. Such a fragment is shown below. Around these rings and holding them together

Shrapnel Bullet.

Portion of Boer Segment Shells.

is the outer cast-iron skin of the shell. At the apex of the shell is a percussion fuse, and within the rings is the explosive charge.

These shells will, in contradistinction to shrapnel, only

PLATE XXIX.

SHELL WOUNDS OF THIGHS.

[*To face page* 169.

burst on contact, and the explosion will shatter the casing and the iron rings, whose constituent fragments, thus released, form rough angular missiles.

The High Explosive shells depend for their destructive power on the violence of the explosion and on the rending into numerous fragments of the shell itself. In this particular they differ from shrapnel shell, of which the bullets obtain their velocity from the momentum of the parent shell, and not from the explosive charge, which simply sets them free.

From what has been said above it will be gathered that shell wounds must vary in extent and severity according to the part of the missile that causes the injury. Shrapnel bullets cause wounds that do not differ materially from those caused by a large-bore bullet, and from our experience we should say that they healed as readily.

Wounds caused by fragments of shell were, as would be expected, of irregular nature and of various sizes, and presented all types from a mere abrasion of the skin to a yawning chasm or total destruction, even avulsion, of a limb.

Plate XXIX. shows a shell wound of each thigh of medium severity, which was caused by the passage of a shell or shell fragment across the back of the thighs while the patient was lying down seeking cover. The skin and deep fascia had been shot clean away and exposed irregular openings in the muscles of the thigh. These wounds, although large, never gave any cause for anxiety, but were a considerable time in healing.

One case of a wound from a "Pom-Pom" shell that came under our treatment was rather curious. The patient, a trooper in the Inniskilling Dragoons, was hit while sitting in the saddle, and the shell passed across both thighs just below Poupart's ligament, causing a long transverse wound on both sides, while in its passage it ruptured one testis and carried away a portion of the glans penis. Luckily

for the man it did not explode until it struck the ground some little distance beyond him.

The explosion of such a shell on touching the body causes either a fatal result or an awful injury, and in the case of a limb the best that can be hoped for is the preservation of life at the expense of the member. If such destruction occurs with small shells, it can be imagined what the effect is when large shells strike the body, or what happens when soldiers are hit with the large fragments of a high explosive projectile. In such cases the body is shattered, the head blown off, or the limbs mangled or avulsed. The wounds of the limbs resemble very much those seen in civil practice caused by machinery or railway accidents, and, as in these, the hæmorrhage is usually, though not always, of small amount. In future wars we believe that such wounds will furnish the great majority of amputations.

The Clinical Course of Gunshot Wounds.

To the civilian surgeons, and also, we think, to the officers of the R.A.M.C., one of the most striking facts of the war was the favourable course that the wounds as a rule ran. There were, of course, exceptions to this, and early in the war there were some cases of bad infection, notably in cases of compound fracture of the femur, after the battles of Methuen's advance on Kimberley, and later among the patients who came back to Orange River after the battle of Paardeberg.

The rapid healing of wounds, which was, however, the rule, is due to several causes: first, and by far the most important, to the small skin wound made by the Mauser bullet; secondly, to the climatic conditions under which the war was fought; and thirdly, to the early application of an antiseptic dressing.

It must also be remembered that the men who received wounds were, as a rule, in the pink of condition. To begin with, the weak ones, if they escaped rejection

at home—and a good many did—were soon weeded out and found their way to the base, whilst the others led a healthy though hard life; and the average soldier, if he escaped enteric fever and dysentery, was as sound and healthy a man as could be wished.

The fighting almost universally took place on the high veld of the great central plateau of South Africa. Here there are open, rolling plains on which are scattered innumerable small hills or kopjes, which often are replaced by regular mountain chains. The climate is one of almost perpetual sunshine, the rain falling mostly in the summer months, and chiefly during storms which last as a rule for short periods only, and are again followed by a bright, hot sun which quickly dries the ground. In addition to this, the air is seldom still. In summer the nights are cool, though the day may be exceedingly hot, and in winter, although the nights are frosty, the sun by day is decidedly warm.

Such a climate must be inimical to pathogenic organisms, and, as a matter of fact, the dust which penetrated all things seemed to have no bad effect on the wounds, whilst the extreme dryness of the air was certainly very beneficial in causing wounds to scab over quickly if not large, whether they were covered by a field dressing or not.

Too much stress, however, must not be laid upon climatic conditions with regard to the healing of wounds, for, as Sir William MacCormac has very properly pointed out, the similar wounds in the Cuban War also did very well in a most unhealthy country.

The small size of the entrance and exit apertures was a fact of the greatest importance, for it practically meant that most wounds were really in the same condition as is a subcutaneous operation wound, and the apposition of the sides of the track and the rapid scabbing completed the comparison.

Large, gaping wounds, however, have also in many

instances done exceedingly well, and they often caused but little pyrexia; although it cannot be said that such wounds were free from organisms, they were apparently free from harmful ones.

Two troopers of the Victorian Mounted Rifles who came under our care are of interest in this connection:— In one the femur was broken in the lower third, and in the other the fracture was in the upper third. The exit apertures were large ragged wounds. Both were taken prisoners by the Boers, and for two days remained in the enemy's hands, the only treatment they received being the application of their puttees as bandages to the wounds; puttees, be it remembered, which had been worn for months, and must have been full of dust and dirt. Yet, although in both patients the wounds were discharging freely when they came to us, one healed without complication, and the other gave but little anxiety, and union took place in both. These favourable results must surely be attributed to the innocuous character of the veld dust, for they were not due to an early application of the field dressing or to the small size of the wound.

The amount of discharge from Mauser or Lee-Metford wounds was as a rule slight, but in some patients a thin serous, blood-stained fluid would be discharged, and especially in the case of large exit wounds resulting from fracture of bone the amount was often considerable, though even then the appearance of pus was the exception. These fracture wounds were obstinate in refusing to heal up entirely, and this must be attributed in part to the bone dust and fragments forced into the tissues, some of which often necrosed and kept the wound open.

With regard to the early application of the first field dressing, it is to be noted that this was most commonly applied within a very short time of the receipt of the wound, and it is certain that much good must have resulted therefrom. It was easy to find out that the men themselves very thoroughly appreciated the necessity of using the

PLATE XXX.

MARTINI—ENTRANCE AND EXIT APERTURES.

[To face page 173.

dressings, and we could quote innumerable instances of men binding up each other's wounds when the skilled assistance of surgeons or orderlies was not at hand. It was seldom that the dressing was not applied within half-an-hour of the receipt of the wound.

The Martini wounds that came under our notice certainly required more attention than the Mauser bullet wounds. The discharge was more copious and the healing slow, scabbing was usually absent, and the wound healed by an open granulating surface. We should say that the amount of local damage, both immediate and remote, done by the Martini was much greater than that caused by the Mauser projectile.

The broad scores of the skin already described as produced by the Mauser were very slow in taking on a healthy action even after the sloughs had separated, and no treatment seemed to have the desired effect in hastening the healing process.

Although a good many bad cases of suppuration occurred, especially about the time of the invasion of the Free State, pyæmia only rarely appeared, and then only in isolated cases, and never assumed the epidemic form. The great majority of cases were of the chronic variety and seldom fatal.

Only two cases of acute septic poisoning came under our notice. They were both gunshot wounds of the femur, received near Dewetsdorp, and both patients died on their way into Bloemfontein, death taking place within three days of the receipt of the wounds. In the same convoy there were several other men with wounds that looked bad on arrival at the Portland Hospital, but which soon cleaned up and healed well under careful treatment.

It is curious to note that the country to the east of Bloemfontein, about Thaba N'chu, and where these men were wounded, seemed especially unhealthy, and many of the most virulent cases of typhoid and dysentery arose there.

Treatment.

With regard to the actual treatment of bullet wounds we do not think that there is anything new to be said. The main object should be to get the surrounding skin thoroughly clean and aseptic, and to obtain occlusion of the wound; failing this occlusion, the wounds should be frequently dressed if the discharge is profuse. No doubt some of the wounded, especially men with compound fractures, suffered from want of clean dressings when on the way from the battlefield to the base, and there can be little doubt that sepsis was in most cases the result of not changing dressings soaked with blood and serum sufficiently often. It is therefore important that sick and wounded convoys should have a good supply of dressings.

When the wound did become septic, the ordinary surgical rules for such cases showed no need of modification.

Our practice in the case of retained bullets was to leave them alone unless they were pressing upon important parts, or lodged in or near a joint, or caused pain, or were under the skin and could be felt, for in this latter position they are likely to be a worry to the patient who has a constant reminder of their presence.

To keep to this rule of not removing bullets requires some determination, for both men and officers have an unreasoning prejudice against carrying bullets in their bodies. Many projectiles were indeed removed at field hospitals or dressing stations immediately after a battle, when there was no need of their being touched, and we have seen incisions made for their extraction suppurating when the entrance wounds were practically healed.

The field dressing consists of a bandage, two safety-pins, gauze, wool, and a piece of jaconet, the whole being done up in a small macintosh bag with a linen cover on which are printed directions. The macintosh bag is necessary to keep out wet, dirt, or perspiration, but the jaconet would be

better omitted, for if applied as directed it causes a retention of the sweat and consequent soddening of the skin, if not an eczema. This result was soon noticed, and the application of the jaconet was dropped.

With this exception we do not think that any better field dressing could be made, if only some means could be devised to keep it on, for there are many parts of the body where it is practically impossible to retain even one dressing, not to mention the two required for the exit and entrance wounds, with one bandage. Strips of some adhesive material would certainly be useful to prevent the gauze or wool from slipping.

We do not believe that a supply of the so-called antiseptic powders would be of practical use; if anything they would be productive of harm, as they might induce handling and touching of the wound by inexperienced hands, and this is the last thing wanted. To get the wound sealed, dry, and scabbed is the ideal, and the present gauze and wool dressing does this admirably by being pervious to air, but yet an air filter.

The quickness with which the wounded were dressed, when the nature of the battlefields and the character of the country is considered, was remarkable, but whether much is gained by the presence of the surgeon in the firing line is doubtful. If he is placed *hors-de-combat* the regiment is left without medical aid, and, moreover, the congregation of people round a wounded man, such as takes place in an attempt to carry him out of action, only draws fire and increases the danger instead of diminishing it. Wounded men have been shot and killed when being helped out of harm's way by an over-zealous friend, and one sergeant, who was a patient of ours, expressed in very emphatic language what he intended to do if he was again wounded and a comrade attempted to move him. We believe that more good than harm would result if where possible the wounded were left until the battle had passed away from them.

Dressings, &c.—Some form of gauze dressing is the best; its actual composition is of no great moment. The Portland Hospital was furnished with cyanide, thymol, and plain gauze, and one seemed every bit as good as the other. For outside dressing we had plain absorbent wool and some tissue.

All dressings should be done up in small parcels in dustproof coverings, as by this means only that amount of dressing required for use need be opened, and so contamination by dust is avoided.

CHAPTER VIII

BULLET WOUNDS OF BONE

It may be said in general terms that the actual experience of gunshot fractures in war did not confirm the very definite conclusions arrived at as the result of experiments in times of peace, so that, although much had been learnt, it was soon evident that there was yet a good deal more to learn on this subject, and that there had been a tendency to be too dogmatic as to the effects of high-velocity projectiles on bones. It is not to be supposed that even now anything like finality has been reached, but the extensive use of the X-rays has nevertheless supplied an accurate knowledge of these injuries that has heretofore necessarily been wanting, and has enabled surgeons to speak with tolerable assurance of much that was formerly speculative.

Speaking only, then, of such mantled bullets as the Mauser and Lee-Metford, it may be said that the effect of these bullets upon bones varies with—(1) Range; (2) Character of the bone struck; (3) Angle at which the bone is struck; and that all these factors must be taken into consideration in order to explain the appearances presented by any given patient.

(1) *Range.*—It may be stated in general terms that the shorter the range the more extensive and severe is the injury of the bone, so that it is evident that the velocity of any bullet constitutes its greatest danger.

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This is contrary to many theories which have been propounded, and which have been based on the belief that a very rapidly travelling projectile was more likely to perforate than to cause extensive fracture, but as has already been pointed out, there is good evidence in wounds of all the tissues that the lateral or expansive effect of all bullets is most marked when their velocity is very high; and this action is more easily demonstrated in injuries of bone than in most other wounds.

It is indeed quite certain that at ranges within 50 yards or so the injury inflicted may so closely resemble that caused by a true expanding or explosive bullet as to resemble the latter in almost every particular, for large portions of bone may be shot away, there may be both very extensive comminution and much pulverisation, and the most serious injury may be inflicted on the soft tissues.

(2) *Character of the Bone Struck.*—At all but very long ranges, it is found that the more dense, compact, and resistant the bone, the more extensively is it injured, and the greater is the comminution. Thus the femur may be obliquely fractured, with large portions of the shaft split off, and much of the bone tissue pulverised, when at the same range a bone like the fibula presents an oblique fracture with but little comminution. Again, at ranges when compact tissue is usually comminuted, cancellous tissue may be bored through without complete fracture. It was, however, very noticeable that simple perforation of cancellous tissue was very rarely met with where the portion of bone struck was slender, and insufficiently supported by surrounding osseous tissue. Thus, perforation occurred more often in the lower end of the femur than anywhere else, whilst bullet wounds of the lower end of the humerus were almost invariably associated with splitting of the bone. Perforating wounds of the tarsus were also common, and in many cases the patella was simply drilled by a bullet—we saw at least eight such

FRACTURE OF ULNA at a Range of 300 Yards, showing a Triangular Piece of Bone separated from the Shaft. (From the same Case as Plate xxxii.)

[*To face page* 178.

PLATE XXXII.

Comminuted Fracture of the Femur, with Extensive Longitudinal Fissuring, at a Range of 300 Yards. (From the same Case as Plate xxxi.)

[*To face page* 179.

cases. On the other hand, perforation of the shaft of a long bone was very rare, and in our experience was limited to one or two cases of perforation of the tibia. We never saw or heard of simple perforation of the shaft of any other long bone, although of course there may have been such cases.

(3) With regard to the *angle at which a bone is struck*, it seems probable that when a bullet passes in a more or less longitudinal direction through the shaft of a large bone, that, meeting with more resistance, it will more effectively break up the bone. It is, however, very difficult to definitely prove this contention, but it seems probable that some cases of extensive splintering at long ranges may be explained in this way.

On the other hand, it is evident that a very slight glancing blow may either simply cut a superficial groove in the bone, or may cause a simple transverse fracture, and examples of these might easily be quoted.

It may thus happen that even (1) at short range, and (2) when a dense bone is hit, such as the femur, there may be none of that extensive splintering which is usual in such injuries, for the glancing blow of the projectile may result in a fracture of very slight severity, even at short range.

There have been very many opportunities in the recent war of observing the different effects caused by bullet wounds of bones at identical ranges, for many men have received multiple wounds, and in not a few of them there have been two or more separate fractures.

The accompanying X-ray pictures of the arm and leg of the same patient show how by a bullet striking the femur full at a range of 300 yards there may be the most extensive splintering and comminution; whilst, at the same range, a blow on the ulna has resulted in a fracture with no material comminution. It must, indeed, be constantly borne in mind that there are many factors to consider in determining the nature and extent of any individual

gunshot fracture, and that no mere consideration of the bullet or the range is sufficient for a proper appreciation of the results observed. (See Plates XXXI. and XXXII.)

THE GENERAL CHARACTER OF GUNSHOT FRACTURES.

Subject to a consideration of the various factors of (1) range, (2) character of bone, and (3) angle of impact, there are certain general characteristics of the majority of gunshot fractures which may be briefly stated.

In the first place, true transverse fractures are of extreme rarity, a fact which can only be ascertained by the use of X-rays, for in many cases where the fractures seem to be transverse a radiograph shows that this is not really the case, and in the absence of a radiograph it can never be certainly affirmed that any given fracture is of this nature. It is quite certain that the opinion of some surgeons as to the frequency of transverse fractures was the result rather of observation of the clinical characters of gunshot injuries of bone than of examination by X-rays.

Oblique fractures with splintering are the rule, and the obliquity is generally very considerable. The length of the fissures running up and down the shaft is generally greatest in fractures of the femur, and diminishes in proportion to the smallness of the shaft of the bone involved; the size of the comminuted fragments varies immensely, as does also their shape, but it is to be noted that in a very considerable proportion of all fractures there is a triangular piece of bone with the base outwards completely separated from the shaft and from other fragments, and if there is only one separated fragment it is very often of this shape.

In addition to splintering there is a certain amount of pulverisation of the bone in most cases; this is always more marked at short ranges, but it may occur at all but extreme ranges, and is one of the chief characteristics of the fractures caused by high-velocity

LONG OBLIQUE FRACTURE OF THE UPPER END OF THE FEMUR.

[*To face page* 180.

PLATE XXXIV.

Oblique Fracture of Femur without Shortening.

[*To face page* 181.

hard bullets, as compared with the older soft and low-velocity projectiles. This pulverisation of bone with formation of numerous very minute and often angular particles is a matter of considerable importance, for these fragments may be scattered in the surrounding soft parts, and even when suppuration does not ensue may necrose and continue to come away, may keep open sinuses for many months, and may cause much suffering and delay in convalescence.

It also happens that in many cases where the wound has closed within a few days and where there has been no suppuration, after a lapse of many weeks or months fragments may work their way towards the surface and may cause suppuration and sinuses till they are removed. Since our return to England we have indeed seen various cases where sinuses have remained open, or, after healing, have again broken down, and in some such cases now under observation a whole year has elapsed without the wound closing soundly. Some caution should therefore be exercised in estimating the length of time required for the complete restoration of the usefulness of the affected limb.

There is another very noteworthy feature in many gunshot fractures caused by the bullets now under consideration, namely, that in a very large proportion of cases there is no such shortening of the limb or such displacement as might be expected from the obliquity and splintering of the fractured ends. Many of these injuries, considered clinically, resemble transverse fractures, and the difference in the setting and splinting of them when compared with the treatment of the ordinary oblique fractures met with in civil practice is of great importance. It is quite remarkable to see by radiograph a severely comminuted oblique fracture of the femur, for example, with only half an inch or so of shortening, and with practically no displacement or sliding of the broken ends; and it is a fact that some such cases can

be quite satisfactorily treated without extension, although this practice is not to be generally recommended.

As a striking instance of this absence of displacement may be mentioned the case of a cavalry sergeant shot through the thigh bone near Thaba N'chu, and subsequently carried on a stretcher for three days with a rifle as a splint, and who had by the fourth day no displacement and only half an inch of shortening. The radiograph showed that he had sustained a very extensively comminuted oblique fracture; but he recovered without any extension being employed, and now walks without the slightest limp, and is not conscious of any difference in length between the two limbs. This case is, of course, unusual, but it is mentioned here to show that even the absence of proper splints for four days, and a transport of more than forty miles, did not cause any displacement of the fragments, so that it is evident they must have been very firmly held together by some means.

It is probable that the explanation of such facts is that in cases of bullet wounds there is not any such tearing of periosteum, fasciæ, and muscles, as is caused by the breaking of a large bone by indirect violence and the attendant extrusion of the broken ends through the soft tissues. It is this displacement at the time of the fracture by the same violence which caused the bone to break, and which is usually absent in cases of gunshot wounds, that explains why there is so little deformity and shortening in many cases, and it is on account of these latter conditions that many authorities have come to the erroneous conclusion that fractures presenting such clinical characters were transverse and not oblique.

Changes in the Bullet caused by striking a Bone.—The effects upon a Mauser or Lee-Metford bullet caused by striking a bone vary both with the bone struck and the amount of resistance offered to the bullet, and also with the distance at which the bullet is fired. The larger and denser the bone and the shorter the range, the more

FRACTURE OF BONES OF FOREARM by a Mauser Bullet at a Range of 1000 Yards, showing Extensive Fragmentation. The apertures of exit and entrance were those of an unaltered bullet.

[*To face page* 182.

EXIT WOUND IN THIGH, measuring 2 inches in diameter, caused by shattering of the Femur by a Mauser bullet. The entrance wound was typical.

[*To face page* 183.

will the bullet be liable to be altered. It thus happens that whilst a bullet may at one time traverse a particular bone unchanged in shape, in other instances the bullet is either altered in shape, or, according to some surgeons, its metal casing may burst open and the contained lead be flattened. It may also be said in general terms that the more the bullet is altered by its collision with the bone at average range, the more likely is it to lodge, for a misshapen bullet meets with much greater resistance in its passage through the tissues.

The characters of the wounds in the soft tissues and especially in the skin in cases where a bone has been fractured necessarily vary very considerably.

In many cases, as has already been mentioned, the mantle of the bullet bulges and allows the bullet to alter its shape, so that its end becomes turned up, whilst in many other cases the bullet does not alter in its shape materially. It thus happens that sometimes the wound of exit in the skin does not differ from that caused by a bullet that has not struck a bone; whilst in other cases, when the bullet is bent and deformed the aperture of exit is correspondingly enlarged and ragged. In yet other cases, where the bullet has broken up, the aperture of exit is still further altered; whilst if there has been extensive comminution and pulverisation of the bone, the aperture of exit may be a large ragged hole, caused by the tearing of the skin by the detached and shot-out bony fragments (*vide* Plate XXXV.).

FRACTURES CAUSED BY EXPANDING BULLETS.

In general terms it may be said that expanding bullets are liable to disintegrate and destroy a considerable portion of the shaft of any long bone they may happen to strike. In such cases it may happen that several inches of bone may be completely shot away, and we have seen large fragments of the bones of the forearm thus destroyed. In all such wounds, in addition to the actual shooting

bodily out of a piece of bone, there is generally much pulverisation and the formation of an immense number of minute fragments, so that on an examination of the part there may be found innumerable spicules embedded in the muscles, and a quantity of bone-dust mixed with blood in the wound cavity.

The bone is also often more extensively split than in cases of wounds by hard bullets, but it must be remembered that at short ranges the ordinary Mauser or Lee-Metford projectile may act much like an expanding bullet, and may cause injuries to the bone which are indistinguishable from those caused by true expanding bullets. We have thus seen about one quarter of the ulna completely shot out by a Mauser bullet fired at a range of about 15 yards.

There can be no doubt that explosive effects are produced much more by the shattered fragments of bone than by any fragmentation of the bullet. It is now generally recognised that the energy of the bullet being transmitted to the bone which is broken, the shattered fragments of the latter are driven in all directions and tear their way through the tissues around them. In some cases much of these tissues is shot completely away, and if the bone struck be close under the skin, a large portion of the latter may be destroyed, so that the wound is excavated and crater-like.

In other cases, however, the torn soft tissues are not shot away completely, but are thrust out as a torn and bleeding mass through the aperture in the skin, the latter being widely torn open rather than destroyed. The largest skin wounds we saw caused by expanding bullets were in the forearm and the leg, and we think that the dense mass of thick muscles around the femur explained why the skin was not so widely torn open when this bone was injured.

Here are two typical examples of "explosive" effects due to expanding bullets striking bone :—

"Explosive Wound" of Right Leg, measuring $3\frac{1}{2}$ inches in diameter, probably caused by a soft-nosed Mauser Bullet. The entrance wound was typical.

[*To face page* 184.

"EXPLOSIVE WOUND" OF RIGHT FOREARM, caused probably by a soft-nosed Mauser bullet.

[*To face page* 185.

L., a trooper in the Inniskilling Dragoons, was shot at a distance of a few yards in the leg—the Boer who shot him then emptying the rest of his magazine as he lay on the ground, and putting another bullet through his forearm. Soft-nosed Mauser ammunition was found in the pouches of Boers killed on this occasion, and rendered it probable that it was with such bullets that the wounds in question were caused.

In the leg the wound of entry was quite small, but the wound of exit was a large, irregularly circular crater, about 3 inches in diameter and an inch or two deep. Under an anæsthetic it was found that a large piece of the shaft of the tibia had been shot completely away, that there was much bone-dust and small *débris* in the muscles, and that the shaft was extensively splintered both upwards and downwards. The fibula was badly fractured, but with less loss of bone. The entry wound in the middle of the forearm was a small aperture, but the exit wound was about 4½ inches in diameter, and irregularly circular. It differed from the leg wound in that it was not a crater-like cavity, but was occupied by a large mass of extruded muscle and fascia filled with fragments of bone, and projecting beyond the surface ot the skin around not less than an inch or an inch and a half. The radius and ulna were extensively comminuted and splintered, and an inch or more of each bone had been shot away.

Under an anæsthetic the injured parts were carefully cleaned, many small pieces of bone were removed, the tibia was wired, and both limbs carefully fixed on splints. Within a few days the temperature was normal, and the patient quite comfortable; the wounds ran an aseptic course, and after the sloughing tissue had come away, they rapidly closed in, so that although the bones were not united, healing was almost completed in both limbs when the patient sailed for England three months later. (Plate XXXVII.)

L. A., a trooper in Kitchener's Horse, was shot at a range of about 300 yards through the right forearm. The bullet entered by a typical small aperture in the upper and outer part of the forearm, and on emerging blew out the muscles and bones through a large hole which measured 6 inches in length by about 5 in width, and was chiefly on the exterior aspect of the limb. An X-ray picture showed that not only was there considerable loss of bone, but that the radius and ulna were also widely separated from each other by the "explosive" effect of the expanding bullet. There was paralysis of the parts supplied by the ulnar nerve, and no pulse in the ulnar artery. (Plate XXXIX.)

The general condition of the patient, in spite of his serious injury, was good, and as he was a sound healthy man, we considered that the limb might be saved. The wound was therefore thoroughly inspected under an anæsthetic, and portions of bone and of torn fascia and muscle removed, and the whole was then fixed on an internal angular splint. The patient did well from that time; the temperature was hardly at all raised, sloughs rapidly separated, and healing continued uninterruptedly, so that the man was soon out of bed, and left our camp *en route* for England in two months and a half, with an open sinus in the place of the large wound, but no union between the bones.

Five months from the time of the injury the patient again came under the care of one of us in London. There was then no union, and two sinuses remained discharging. These were opened up under an anæsthetic; one or two minute sequestra were removed, and the fractured ends were freely scraped, the limb being again put on splints. At the present time, about nine months after the wound being inflicted, one sinus has closed, the radius has soundly mended, and the ulna also is nearly firm, so that there is but little doubt that good union will ultimately result in both bones. The ulnar paralysis passed away in about three or four weeks, and of the torn muscles the flexor profundus digitorum alone seems permanently damaged.

Expanding Bullet Wound of Bones of Forearm, showing the separation of the Bones by the explosive effect of the projectile.

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PLATE XL.

BONES OF FOREARM from the same Case as Plate xxxix, after an interval of Eight Months. The Bones have come together and the Radius has united.

[*To face page* 187.

General Treatment of Gunshot Fractures.—As in the treatment of all compound fractures, so also in these it is a matter of the first importance to ensure as strict asepsis as is possible, and, with this object in view, the early application of a first field dressing should in all cases be followed as soon as practicable by the thorough cleansing of the skin and the wounds. And it is further important, with the same object, namely asepsis, in view, that the dressings should be changed sufficiently often in all cases where there is much sanious oozing, such as is often seen in many fractures. To the want of sufficiently frequent dressings in the early days of this war may indeed be attributed some of the most serious cases of profuse suppuration which occurred at that time, and it was the experience gained then that resulted in the more efficient treatment of the later cases.

The next question that always calls for early decision is, whether to open up the wound and remove loose fragments, or to treat it by antiseptic occlusion ; and it may be said in general terms that the character of the external wound is in such cases a fairly safe guide. When the opening of exit is quite small, it is never necessary to do more than apply a dressing before putting on splints ; but when, on the other hand, there is a large ragged opening, it may be concluded that there has been a good deal of bone shot off from the shaft, and that there are fragments that had better be got rid of at once.

In all such cases, then, when the patient has arrived at a hospital where he can be at least temporarily retained, the wound should be examined under an anæsthetic, and all obviously loose and detached fragments that readily present should be removed. It is neither necessary nor advisable to make extensive incisions, nor to make prolonged search for pieces of bone. So long as the finger can be freely introduced, there is nothing gained by exposing the broken bone so as actually to inspect its condition. It will often be found that beneath a ragged

wound there is a considerable cavity in the soft parts ; and in cases of short-range wounds, with much pulverisation, a great deal of bone-dust and minute fragments can be felt amongst the muscles, and should be wiped out with sponges or removed with forceps.

In cases where explosive effects are marked, it is usually impossible to get rid of all fragments, for many of them are driven very deeply into the muscles and cannot be felt; but in all such wounds there is generally so large an external opening, and so much bone is lost, that a complete inspection of the injured part is easy, and the broken ends can generally be everted through the skin wound, if it seems desirable, in order to obtain a more accurate knowledge of the extent of the injury.

In all cases large fragments which have any attachment to the shaft should invariably be left, for such fragments do not generally necrose, and the loss of bone is already sufficiently serious to make the surgeon anxious to retain all that can possibly be saved.

It is also most necessary that, especially in fractures of the lower extremity, the patient should be kept at rest for at least a few days after the cleansing of the wound and the removal of fragments, for in all such cases there is liable to be much oozing of sanious fluid, and frequent dressings are required to maintain asepsis. The moving of patients from ambulances to trains, and *vice versa*, with often at the best improvised splints and imperfect immobilisation, has been the cause of many serious, though unavoidable, complications.

With regard to the application of splints, it may be said in general terms that such splints should be selected as will permit of the most ready access to the wounds, whilst at the same time they sufficiently immobilise the parts. It is of course obvious that there is room for some surgical ingenuity in the treatment of individual cases, but we may mention that some lengths of suitable soft iron of various diameters, together with screws, will be found useful

in making the necessary interruptions in wooden splints. It is better to be provided with some plain wooden splints, and to make the interruptions where the wounds require them, than to try and take out to war a sufficient supply of interrupted splints.

The fixing of fragments by pins, screws, or wires did not seem to us to be often required, and we were somewhat surprised to find that this was the case. The merits of the various mechanical appliances for fixing fractured ends are of course always a matter of opinion, but it has seemed to us that the drilling of the broken ends and the insertion of strong steel pins passed obliquely through both fragments provides a more firm and steady support than either screws or wires, though it is evident that either of the latter may in some cases have distinct advantages over the pins.

The question of amputation is very naturally one that presents itself for consideration in connection with fractures of bone, but it may be truly said that it is not of nearly so great moment as it has necessarily been in former wars. In our own patients at the Portland Hospital there were none that needed removal of the limb, and it may be said in general terms that amputation was but rarely required for bullet fractures of bone, apart from other complications.

It seemed to us that the scope of conservative surgery was practically unlimited in such cases if the patient could be put under favourable conditions for treatment, and the mere loss of large portions of bone never seemed to us to warrant the sacrifice of a limb.

It is true that in such cases union is very much delayed, and that in some cases the bones do not unite at all, but, in the first place, it must be remembered that union may be delayed for five or six months and may yet be completed ultimately; and, in the next place, that even if union fails, surgery may yet bring about the desired end by bone-grafting, especially if the want of union is merely due to loss of bone. The patients are usually healthy men in the prime of life, and in all such there is a strong natural

tendency to repair, so that fractures in them seldom remain ununited.

We have already alluded to the three extremely shattered limbs caused by expanding bullets under our own care, in all of which, as far as mere extent of injury to bone and muscle were concerned, the wounds were as severe as could well be imagined, yet all of these did well and never gave us any real anxiety. We also saw many other cases in consultation, and never advised amputation as far as mere extent of bone injury was concerned, nor had reason to regret subsequently the saving of the limb.

On the other hand, the question of amputation must necessarily be raised in many cases where the parts have become septic, and where profuse suppuration threatens life. Much will, of course, depend on the part injured and the amount of constitutional disturbance, but here, as in civil practice, the cases of suppuration of compound fractures of the upper extremity are by no means so serious as are those of the lower extremity, and the danger to life is infinitely greater in the latter.

No hard and fast rules can be laid down, and each case must be considered on its merits, but with sufficient care in dressing, and with good drainage, timely incisions, and proper fixation with splints, even the most unpromising cases may be saved. Some of our own fractures of the femur were beginning to go wrong when they arrived in hospital, and we saw many others elsewhere where suppuration and sepsis had commenced, yet in the great majority of these a satisfactory result was obtained. One of the worst cases of this kind occurred in an officer who was shot near Paardeberg, and who, we were told, did not get to the Field Hospital till the third day after the injury, having been lying out in a remote place for some time before he could be brought in. After temporary splints had been supplied he was taken to Kimberley, about 30 miles distant, and placed under the care of Dr Ashe at the Civil Hospital, where one of us saw him two or three

days later. By this time the thigh was distended with pus and decomposing blood over more than half its length, and the femur was most extensively comminuted. The patient also was extremely exhausted and suffering from severe sepsis, yet with these most unfavourable conditions both limb and life were ultimately saved by Dr Ashe, though the femur remains considerably shortened.

There is, of course, very great risk to life in trying to save such limbs, yet it is probable that in cases of fractured thigh the danger of amputation is quite as great, and always will be so.

Many of these patients are extremely exhausted by pain, sepsis, and transport in their weakened condition, and a large number of them would certainly succumb if treated by amputation. If seen at such a time it must almost always be wise to wait, so as to gain time and improve matters by palliative measures, and then if it is evident that the limb must be removed, the sooner a transient favourable condition is taken advantage of the better, for there will come a time when with advanced sepsis the last chance is gone, and amputation only hastens the end.

The splint we found most useful for wounds and fractures below the knee that required much dressing was Neville's leg splint with cradle. Hodgin's wire splint was excellent for compound fractures of the femur, and was much appreciated by the patients; the requisite masthead we made out of a pole fixed in a barrel with concrete. The constant powerful extension which can be applied by this splint, and the facilities it offers for dressing the wounds without disturbance, are certainly points in which it is superior to any other.

For fractures of the upper extremity we found the common external or internal angular splint the most useful.

We also had a quantity of thin pine board 3 inches wide, from which we cut the necessary lengths for long

outside splints, and found this a convenient method, as the heavy, hinged, army pattern thigh splint is not to be recommended. From narrow soft iron strips, with which we had provided ourselves, and such as are used for making Thomas's hip splints, we were able to manufacture a Hodgin's splint, and we also cut the same strips into short lengths for strengthening plaster-of-Paris splints. These latter were made from coarse flannel and plaster-of-Paris, as well as from the plaster bandages ready rolled in tins.

Aluminium could advantageously be used for Neville's, Hodgin's, and internal angular elbow splints, whether of the fixed or hinged pattern, and also for an operating table where lightness is of great moment.

PLATE XLI.

MAUSER BULLET LODGED IN RIM OF ACETABULUM.

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CHAPTER IX

BULLET WOUNDS OF JOINTS

In the Portland Hospital alone we had examples of bullet wounds of all the large articulations, and in none of them were there any serious complications. This statement will perhaps convey a more accurate estimate of the dangers of joint injuries than a great deal of argument, and we will only add to it by saying that in most of the cases we saw in other hospitals the joint lesion caused but little anxiety apart from the comminution of the articular bone.

Most cases, indeed, of bullet wounds of the joints healed without any difficulty, and gave rise to but little synovial effusion. Thus, a gunner shot through the right shoulder joint from front to back was able to return to his battery in five weeks' time, passive movements having been commenced about fourteen days after injury; in eight cases of wounds of the knee where the bullet perforated the patella, a perfectly movable joint resulted, although in some of the patients there were complications from wounded vessels or nerves; a bullet through the wrist joint caused hardly a temporary stiffness, and in three cases of perforation of the ankle joint in various directions there was no sign of joint trouble from first to last.

On the other hand, there was occasionally some long lasting stiffness, even in the absence of suppuration, and of this the following is a very good example:—

N

A young officer was shot through the knee near Dewetsdorp whilst riding, and at first suffered so little pain that he kept on his horse. A short time afterwards his wounds were dressed, and by night-time he had some more pain. He was then put on to an ox-waggon with a dose of morphia to keep him quiet, and this was subsequently assisted by a large ration of rum, the effect of which was that he got out of the cart in the night in a state of delirium, and was found on the ground trying to help the waggon on its way. Next day his knee was much more swollen and painful, and, although the wounds healed quickly and well, and he had no pyrexia, there was some effusion into the joint, and a good deal of pain and aching. The leg also could not be put straight in spite of splints and weight extension, and when he left for home it was still very stiff, though no longer painful. After this adhesions formed, and had to be broken down on several occasions, so that nearly a year elapsed before there was much movement; but when last he was seen the limb promised to make a good recovery, and he could walk fairly well.

In another case a cavalry man was shot by a ricochet bullet which passed through the left thigh and into the right knee joint, where the bullet lodged. When admitted two days later, he had but little pain in the knee, though there was some swelling and effusion in the joint. He was, however, very ill, with a temperature of 104°, and at first sight it seemed that he must have some septic condition. The local signs, however, did not at all agree with his general condition, so no incisions were made, and it was soon apparent that the man was in the second week of typhoid fever. As he was very seriously ill we decided not to attempt an operation for removal of the bullet, and a very severe attack of enteric ran its course without any local complication in the wounded knee, although the aperture of entrance was a large ragged wound which did not heal for three weeks. At the end

RICOCHET LEE-METFORD BULLET which has entered the Knee-joint Base first.

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of the illness, six weeks after his wound, we removed the bullet which had entered the joint base first, and when we returned to England we again had the opportunity of seeing our patient in excellent health, the stiffness of the knee quickly yielding to breaking down under an anæsthetic and massage, and the joint becoming subsequently perfectly sound and useful (Plate XLII.).

Treatment of Joint Wounds.—It seemed to us that the wounds of joints when there was no material bone lesion, merely required such care in dressing as did wounds of the soft tissues, together with the application of splints to keep the parts at rest. It is certainly not necessary in such cases to open the joint and to wash it out in the way that may be needed in punctured wounds in civil practice, and there can be no doubt at all that such treatment in war would be thoroughly bad if carried out systematically, and that many joints so treated would suppurate.

In those cases where the wound of the articulation is complicated with fracturing and perhaps comminution of the articular bone, the treatment becomes that of the fracture rather than of the joint lesion, and the removal of fragments and the splinting of the limb should be proceeded with just as if the joint were not involved.

There can indeed be no doubt that formal excision of joints for gunshot wounds is not to be recommended, and can hardly ever be required, so that the practice of excision as a routine method of treatment for all such injuries when caused by the small mantled bullets mostly used in this war may be said to be a thing of the past.

Extensive comminution of bone is indeed no indication for excision, and we are of opinion that resection is never indicated as a primary operation for bullet wounds of any joint, although it may well be necessary to remove many shattered fragments of articular bone.

We are further of opinion that, if the case is not complicated by serious or extensive injuries of the soft tissues,

and especially of large vessels and nerves, primary amputation is not required merely because a joint is opened and the articular bone comminuted. It is indeed possible that in some cases of extensive fracture into the large joints of the lower extremity, and especially the knee, amputation may be indicated, because there is no possibility of adequately treating the part by proper splints and rest; but if the case is to be considered solely on its own merits, then amputation for a comminuted fracture with opening of a joint is not in our opinion ever to be recommended as a routine operation in either of the extremities.

In all these cases, however, as in the case of fractures without joint lesions, the gravest complication is septic infection, and although in the absence of this the most serious wounds did well, it need hardly be insisted upon that sepsis is doubly dangerous when it involves not only an extensive fracture but also a joint cavity. It may be said in general terms that here, as in all cases of suppurative arthritis, free incisions and thorough washing out are indicated, and here also good results may sometimes be obtained in even the worst cases if the patient can be placed under favourable conditions. It did not seem to us that in such cases excision promised much good, whatever joint was involved, and in the only case in which we saw it practised, namely, a suppurating elbow, the limb had subsequently to be removed. It is possible that an exception might be made in the case of the hip joint, considering the desperate nature of amputation as an alternative, but in the case of other articulations, the choice seems to lie between free incision and removal of the limb, though it is evident that here, as in the case of profuse suppuration complicating fractures, the risk to life when amputation has to be done under these conditions, is very great indeed.

MAUSER BULLET, apparently in the hip joint, but really lying under the Skin of the Groin, and greatly magnified as the result of its Distance from the Photographic Plate, which was placed under the Buttocks.

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CHAPTER X

BULLET WOUNDS OF BLOOD-VESSELS AND THEIR COMPLICATIONS

General Considerations.—Before the commencement of this war much speculation was rife as to the influence of the modern small-bore bullet on the question of death from hæmorrhage, and the accepted view was that deaths from wounds of large vessels would be more frequent in future than they had been before. This conclusion was arrived at from the fact that the modern projectile cuts a much cleaner hole than the older one, and, in addition, it was supposed that by reason of its great velocity and small size it would penetrate rather than push aside any vessels in its course. The clean nature of the wound would, it was thought, also favour bleeding and hinder natural hæmostasis by retraction of the arterial coats. It is curious in the light of attained knowledge to find that while the basis on which these arguments were founded has proved to be correct, the deductions from them are by no means fulfilled.

Hæmorrhage has varied according to the part hit. Flesh wounds in which no large artery has been wounded have bled but little, and in many cases have healed under the field dressing, which, sealed to the wound by the drying and coagulation of the blood, has formed a perfect scab, so that often the area of the dressing stained with the blood has been no bigger than a sixpence. At other

times the bleeding has been so free as to require the application of a tourniquet, but with few exceptions this has been removed without a recurrence of the bleeding when the patient has reached the Field Hospital.

In wounds of unimportant parts the small amount of bleeding is to be ascribed to the nature of the wound, which partakes of the character both of a lacerated wound and a stab. It resembles a lacerated wound in that the tissues are torn through, as evidenced both by the irregularity of the scars and also by the tears rather than perforations often seen in the skin exits and entrances, and this irregularity, together with the dead tissue in the immediate track, favours coagulation and arrest of the hæmorrhage. In addition to this the small size of the bullet and its narrow track allow the elasticity of the tissues to exert a decided pressure on the bleeding point as in a stab wound, whilst when the wound traverses muscle any alteration in position also causes the opening through the tissues to become valvular.

Wounds of the Larger Vessels.

Primary Hæmorrhage.—One cannot help being struck with the charmed life that the vessels have borne in many instances. When the direction of the track of the bullet has been studied by an examination of the entrance and exit wounds, it has seemed almost impossible to escape the conclusion that large vessels have been wounded without the appearance of unfavourable symptoms, or that they have been pushed aside by the bullet.

It might naturally be thought that the wound of a large vessel without grave and unmistakable symptoms was an impossibility, but experience shows that such wounds may cause very slight signs, and permits the suggestion that such an accident may occur, and yet produce no obvious symptoms. On the other hand, it must be borne in mind that the true course of a bullet can only be ascertained after the body has been placed

in the same position in which it was at the time of the receipt of the injury, and also after considering whether the skin was not pulled or pushed aside by the traction of the clothes or contact with some other object. In this connection it is interesting to note that patients have received multiple wounds, which, in spite of their assurance to the contrary, it was very hard to believe were caused by one bullet until the patient put himself in the posture in which he received the wound.

The two following cases show how close at least a bullet can go without producing any obvious wound of a large artery:—

(1) W. S., Private, Coldstream Guards, was hit while in the prone position at Magersfontein. The bullet (Mauser) entered the right orbit and destroyed the eye. It then traversed the superior maxilla and entered the mouth through the soft palate, and afterwards, passing out of the pharynx below the tonsil, emerged from the neck just behind the posterior border of the sterno-mastoid muscle, to re-enter the neck above the clavicle, which it smashed, and then passed away.

In its passage it must have divided or seriously injured the vagus nerve inside the carotid sheath, for the vocal cord on that side was completely paralysed and did not recover; the great vessels of the neck never showed the slightest evidence of injury.

(2) G. W., trooper, Sixth Dragoon Guards, was accidentally shot by a Lee-Metford at a range of 10 yards. The bullet entered immediately below the sternal head of the left sterno-mastoid muscle and emerged one inch below the spine of the left scapula. The man had no symptoms of internal injury at all, though how the large vessels in this region escaped is beyond explanation.

We have made inquiries of many officers with bearer companies and field hospitals, and they are all agreed that immediate hæmorrhage has been but rarely fatal on the battlefield as far as the vessels of the limbs are concerned,

although we have known of patients who have bled to death from wounded femoral, brachial, axillary, or carotid arteries. There is, however, good reason to believe that deaths do occur frequently from wounds of large vessels of the trunk, both on the field and in the field hospitals, but the lack of post-mortem records of the nature of fatal wounds must at present leave a great deal of uncertainty on the subject. Even when a large vessel is injured the amount of blood poured out at the time differs in various patients. There may be no bleeding either internally or externally, or it may be so slight as to not attract notice, or, on the other hand, so profuse as to threaten the life of the individual, a result that has been most common in wounds of the neck.

In other cases, again, tourniquets have been applied to limbs to arrest bleeding on the field which presumably was profuse, but on removal of the tourniquet in a Field Hospital the bleeding has usually failed to recur, though in one such case the popliteal artery required ligation, and in two others (Surgeon Lieut.-Col. Magill) acute traumatic aneurysms formed.

Secondary Hæmorrhage.—As in civilian practice, this was specially liable to occur in septic wounds, and was met with particularly in cases of bad compound fractures of the lower extremities. It presented no special symptoms, and the treatment needs no particular mention except to note that, though with aseptic modern methods local ligature of the artery may save the necessity for the ablation of the limb, most of these cases came to amputation.

Alteration of Pulse in Arteries not Obviously Wounded.—In some cases where the artery has not been obviously wounded, the pulse has been reduced in volume or has even ceased altogether, and in a case seen by one of us the brachial pulse was quite absent, although there never had been a sign that the artery had been touched by the bullet which had passed very close to it.

It must be supposed that in such cases the bullet either

contuses the artery or ruptures the internal coat, and so gives rise to thrombosis and permanent occlusion, or that possibly the vessel is caught in the scar and contracted by its embrace. Another possibility is that the artery is actually wounded, and subsequently thrombosed, although no blood escapes externally or collects in the tissues.

Diffuse Traumatic Aneurysm.

The effusions of blood met with in connection with wounded vessels, although they presented many points of difference, had many points in common, and showed all variations between a well-defined aneurysm at one extreme, and a slight recurrent hæmorrhage at the other. Diffuse traumatic aneurysms have occurred both in small and large arteries, such as the tibials, vessels of the forearms, carotids, popliteals and gluteals.

The length of time between the receipt of the injury and the indications of the aneurysm has varied very much. In those cases where there is also external hæmorrhage blood may continue to ooze from either the entrance or exit wound, but more commonly from the latter, even though it be the farthest from the wounded vessel; or the bleeding may only occur at short intervals. A definite tumour may be present or absent, and the blood may pass far and wide into the limb, or may in part collect around the wounded vessel, and partly find its way along the bullet track to the surface. In some cases all goes well at first, the wounds heal, and no particular attention is paid to the injured part until it is found that the scar is getting shiny, stretched, and blue, or that possibly the limb is swollen at the seat of injury, whilst palpation gives rise to a more or less definite fluctuation. At a later stage the scar may yield and bleeding occur, or, as has actually happened, the swelling may be incised under the supposition that an abscess is forming.

It might be thought that the diagnosis between an aneurysm and an abscess presented no difficulty, especially

in the absence of inflamed skin, but it must be borne in mind that sometimes effusions of blood give rise to very decided elevations of temperature, and that pulsation under the conditions we are now describing is usually absent.

A patient kindly shown to us by Captain Browne, R.A.M.C., at No. 3 General Hospital, was a case in point. Here a soldier had been shot by a Mauser bullet through the leg in an antero-posterior direction three weeks previously, and had been sent down country as convalescent. The wounds were healed, but a day or two after arrival at Rondebosch the calf was found to be swollen, and the scar glistening and slightly protuberant. The temperature was raised and a sense of fluctuation obtainable. Although a blood effusion was thought most probable, a purulent collection could not be excluded. An incision revealed a cavity filled with dark blood-clot and fresh bright fluid blood, and a wound in the posterior tibial artery was found and treated by ligation at the seat of injury.

Elevation of temperature, due merely to effusion of blood into the tissues, was also present in hæmarthrosis and hæmothorax, and in the latter it was especially well marked and very constant (see p. 258).

It occurred also under other conditions, and the following case presents some points of interest in this connection :—

A. K., a Boer, aged 23, was wounded in the fighting near Dewetsdorp on 29th April. The range was about 500 yards, and he was running at the time. Both entrance and exit wounds were small and scabbed over when the patient was admitted to the Portland Hospital. The former wound was on the outer side of the knee joint, and the exit was on the inner boundary of the popliteal space, and one inch above the joint, which had evidently been traversed. The whole limb was swollen, the thigh œdematous on pressure, and the calf brawny as well. Temperature was 103°. There was fluid in the joint, but no

tenderness. As sepsis was suspected, some incisions were made, but only serum exuded; the temperature became normal in a week, and the patient was discharged cured in one month.

At the time of admission the condition of the limb seemed serious, and this, taken in conjunction with the fact that two men in the patient's convoy had died of sepsis, made the prognosis doubtful. As the leg had been exposed to the sun the redness of the skin might have been thus accounted for, but on the whole it seemed the safest course to incise, and this was done with a negative result.

Looking back on the case in the light of further experience, there is now but little doubt that the swelling was due to effusion of blood, and the subsequent history bears this out. In our experience, such extravasations as this when large vessels were not opened almost invariably subsided of themselves, the temperature gradually falling as the swelling and tension passed away.

When, however, a large vessel is injured, an acute traumatic aneurysm may arise at once or in a few hours, and then produces the classical symptoms of pain, swelling of the part, and coldness and loss of pulse in the extremity. The hæmorrhage may be only internal, or both internal and external. If external, it may be so profuse as to threaten life, but even then it may possibly spontaneously cease, and the wound may heal, the diffuse aneurysm becoming circumscribed and gradually contracting to a definite tumour. On the other hand, such a favourable result is most unlikely, and the effusion of blood then either remains indefinite, tense, and thin-walled, with more or less well-pronounced pulsation, or, after some indications of circumscription, again increases in size, and shows by its extension that surgical interference cannot be delayed.

In yet other cases the symptoms are much more obscure. An indolent swelling which appears to be a hæmatoma forms, and the absence of pulsation and of the

other signs usually connected with aneurysm may well lead to an erroneous diagnosis. Thus, in one case brought to our notice by Mr Jameson, a man was shot through the superior maxilla, the bullet passing obliquely backwards and emerging by the side of the sterno-mastoid. The exit wound healed, but the entrance wound remained open, and discharged clotted blood, while a hæmatoma formed over the cheek. As the swelling remained stationary and there was no pulsation, it was thought advisable to turn out the clots. This was done, and the incision was followed by violent hæmorrhage, for which the common carotid had to be promptly tied, the patient subsequently making a good recovery.

This case is one of many which should cause every surgeon to look with the greatest suspicion on all "hæmatomas" that do not quickly subside.

Circumscribed Traumatic Aneurysms.

These arise clinically in two ways: either by the circumscription of recently extravasated blood, or more usually without previous sign, some ten days to three or four weeks after the original injury.

It is not clear whether these late-appearing aneurysms would give signs of their early formation if all likely cases were carefully watched, but as in most cases in South Africa the wounds healed so well, and renewal of the dressing was not needed, it often happened that some time passed by during which no examination was made, and then perhaps only with a view of seeing if the patient was fit for discharge from hospital. In many instances, indeed, aneurysms have been found, so to speak, accidentally, by the patient himself, and this was especially the case when a communication with the vein existed, the patient noticing the thrill when, after the wound was healed and the dressing removed, he for the first time put his hand near the seat of injury.

These late-forming circumscribed aneurysms are well-

defined, rounded swellings, with usually a fairly well-marked expansile pulsation, but are generally harder, we should say, than those seen in civil practice and caused by disease; in fact they often rather suggested an aneurysm becoming filled by clot and on the way to become consolidated. The general tendency was for them to become smaller, harder, and more defined, and we have not ourselves heard of such late-forming aneurysms becoming diffused. Spontaneous cure has also been observed to occur, and, as Mr Treves remarked, "certain traumatic aneurysms with distinct and widespread pulsation have vanished with rest." The pulse was not always affected, being sometimes fainter than that on the opposite side, while in other patients there was little or no difference observable.

The size of the aneurysm necessarily varied with the vessel on which it was formed, so that aneurysms of the ulnar and radial arteries were small in comparison with those on vessels such as the popliteal and common carotid. In connection with this latter artery we have seen one case in which there was a small hard swelling no bigger than a pea, which was without pulsation but firmly attached to the vessel, and, as the bullet had injured the cervical sympathetic, it is within the bounds of possibility that this swelling was caused by an injury of the carotid.

Perhaps the commonest site for an aneurysm was the popliteal space, and many in this region were made of greater interest by the fact that the bullet had perforated the patella and the knee joint. It was in these cases especially that the formation of the aneurysm escaped notice, as the leg was put on a splint and the knee joint at first was the centre of interest. If this did well and the temperature and general condition gave no cause for alarm, no reason offered to explore the popliteal space, and so it escaped examination till the splint was removed.

Aneurysms have been recorded on most of the vessels of the extremities, and hardly one artery of the limbs

of any size has escaped. Tibials, popliteal, superficial and deep femorals, ulnar and radial, brachial, axillary, carotids, and subclavian have all suffered, but of these the brachial has been the least commonly involved.

The following may be taken as a typical history of a circumscribed traumatic aneurysm forming unnoticed some time after the infliction of a wound :—

B. W., Private, 4th Derby Militia, aged 18 (his regimental age was over 20), was hit on 7th June by a Mauser bullet at 1000 yards range. The entrance wound was above the outer part of the spine of the right scapula, and the exit was half an inch below the episternal notch in the mid-line. The anterior wound bled profusely, and the blood saturated the tunic and trousers of the patient. When seen on 7th July there was a pulsating swelling on the right side of the neck, extending from the episternal notch to the third part of the subclavian. It was not very prominent, but the pulsation was distinctly visible when the patient stood upright. There was a definite systolic bruit, and the right radial pulse was weaker than the left. The clavicle appeared rather thick and prominent. There was no sign of vein injury.

There was also some weakness of the right arm, and pain referred to its inner side suggesting pressure on the lower nerves of the plexus.

In spite of these conditions, however, on being questioned about the appearances of the tumour the patient appeared to be hardly cognisant of its existence, and was unable to say if any one else had seen it.

Nature of Lesions of the Vessels, and Mode of Production of Traumatic Aneurysms from Bullet Wounds.—The wounds which have resulted in the formation of aneurysms have almost invariably been caused by bullets. A few may have been caused by bone fragments, but in spite of the proximity of large arteries to the shattered shafts of long bones, such occurrences have been rare, and this is remarkable when the nature of the bone fragments and

their comparatively wide dispersion are remembered. When, however, splinters of bone have been responsible for injuries of vessels, such wounds have generally been irregular, and often of considerable longitudinal extent, and we do not think that many, if any, aneurysms have arisen from these lesions, for by their very nature and the damage done to surrounding tissues, the resulting bleeding has been immediate and profuse.

When opportunity has offered to examine the bullet wounds of arteries, they have been found to be more or less clean-cut holes. The bullet in striking them has punched, one might say bitten, a piece out of the circumference. If the axis of flight of the projectile has approached a right angle, the hole forms more or less of a circle, but becomes an oval aperture if the flight of the bullet is inclined to the axis of the artery. Complete division of both artery and vein has also been noted.

The absence of all bleeding in some cases, coupled with the late appearance of aneurysm after the wound has healed, favours the theory that in such cases the aneurysmal tumour is due to a partial division of the arterial wall with subsequent yielding of the coats, or else to the contusion of the vessel by a bullet which does not wound it, but subsequently weakens the wall by sloughing of the bruised tissue. It is, however, probable that many other aneurysms are the direct outcome of a wound opening the lumen of the vessel, and are strictly comparable to those met with in civilian practice where the injury has been inflicted with a sharp weapon. In wounds of the limbs, where the vessels are supported by strong muscles and dense fascia, the small slit-like track is easily closed, and where the bullet has passed through much depth of tissue before penetrating a vessel the cessation of external hæmorrhage by the pressure of surrounding structures and effused blood is easily understood.

One case of which we heard seemed to show that not even such pressure was absolutely necessary to arrest the

bleeding for the time at least. In this case the man was shot through the upper part of the chest, and developed a hæmothorax and empyema. A rib was removed for drainage, but a few days later the patient died of a sudden hæmorrhage, and a post-mortem examination revealed that the subclavian artery had an aperture in it large enough to admit the tip of the little finger.

In other cases where the pressure naturally exercised by the tissues has been insufficient to stop external bleeding, artificial pressure applied by dressings and bandages has brought about the same result. But though the external bleeding is thus stopped, blood may continue to pass into the tissues around the vessel, and the wound in it being thus kept open, a cavity containing blood is formed by the force of the circulation. After this, the clotting of the blood and the condensation of the neighbouring structures by the growth of fibrous tissue soon produce a tolerably firm and definite sac, which in many cases effectively circumscribes the blood extravasation, and results in the formation of a circumscribed traumatic aneurysm.

The possible events resulting from a bullet wound of a large artery may be thus summarised :—(1) The artery may bleed so violently as to cause death, unless treated by pressure or immediate ligation; (2) a diffuse aneurysm may form with more or less widespread extravasation into the tissues; (3) hæmorrhage may recur at short intervals, or the wounds may heal, and later again break down and discharge blood; (4) a local tumour may form, and may either pulsate or simply appear as a hæmatoma. After a while this tumour may either become more defined, rounded, and harder, or the aneurysm may increase and tend to become diffused.

Treatment.

The treatment of primary hæmorrhage is very clear. In the vast majority of cases, rest, pressure, and careful

bandaging, with elevation of the wounded limb, will suffice, but if they do not, then the surgeon should follow the classical rule of tying any large vessel above and below the seat of injury. If the main vein is injured it should be tied, or a lateral ligature applied if this seems possible. When primary hæmorrhage has ceased, then operative treatment of blood extravasations must if possible be put aside for some time, for experience has shown that they often tend to become smaller, harder, and more defined, which means to the surgeon greater facility in operation if the time does come for interference.

If, on the other hand, a diffuse aneurysm forms and shows signs of rapid extension, as indicated by increasing swelling and tension in the limb, no time must be lost in cutting down and securing the bleeding vessel above and below the seat of injury. Although, however, this is the ideal treatment, it must generally be modified in the neck, and here the surgeon is justified in tying the main vessel as close as possible on the proximal side of the lesion. The reason for this departure from the classical rule is the extreme difficulty in telling which of the carotids is involved, and because any open operation is, from the difficulty of restraining the bleeding, likely to be dangerous, if not fatal, to the patient. It must be remembered, however, that although such treatment will suffice to cure the large majority of aneurysms, yet it may prove to be only a temporary expedient to save the life of the patient, and that such a ligature, though it is likely to stop the rapid diffusion of the blood, may possibly fail to cure the aneurysm, in which case it will be a question later on what measures are to be taken to obtain a permanent cure.

It was soon found out that the circumscribed traumatic aneurysms met with in the recent war had to be treated very carefully. Many operators were tempted to apply ligatures in continuity, after the Hunterian method; but in the lower extremity—and it was most frequently done here—this was very often followed by

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gangrene; and even the better planned operation of Anel was by no means free from disastrous consequences. Some operations for ligature of the superficial femoral artery in Scarpa's triangle for aneurysms in Hunter's canal or in the popliteal space were thus followed by death of the limb, and often, as far as could be seen, this was from no fault in the performance of the operation.

One case of a small varicose aneurysm high up in the popliteal space, which we saw treated by ligature of the superficial femoral just in front of the adductor magnus, was quickly followed by gangrene reaching so high up the leg that there was no possibility of a lower operation than amputation through the lower third of the thigh. Yet this ligature must have been placed very close to the aneurysm.

Why gangrene occurs so frequently it is difficult to see, for one cannot imagine that if a ligature was applied at the bleeding spot immediately after the injury that this would be followed by gangrene in a young man with sound vessels. It may be that the effusion of blood checks the collateral circulation by its pressure, and that it should be evacuated. It is certainly true that in traumatic aneurysm the tumour grows more rapidly than in aneurysm due to disease, but hardly quickly enough, one would suppose, to account for any great defect in the circulation, and the latter, moreover, is as a rule very good in the limb below the seat of the aneurysm. Palpation of the tumour also in these cases did not give the idea that the tissues were under any tension, and some of the aneurysms that were treated were in the period of contraction. It seems to us that the explanation of the gangrene which so often occurred is at present unsatisfactory, and that further investigation of these cases is required.

In the upper extremity the occurrence of gangrene was not nearly so marked, but caution was here also necessary.

With regard to the treatment of these cases, as far as our own opinion is concerned, we think that if possible the period of time that should intervene between thé appearance of the aneurysm and the application of a ligature should be considerable, probably not less than three months, and that every opportunity should be given to treatment by rest and perhaps by pressure in the meantime. An exception is, of course, to be made in diffusing aneurysm, small aneurysms of the vessels of the forearm, and possibly of the brachial artery.

The actual method of treatment varies with the situation. The small aneurysms on the ulnar and radial arteries can be easily and safely cured by excision. In the larger varieties the application of a ligature immediately on the proximal side of the aneurysm will be sufficient if it is clearly known from which artery the aneurysm springs, but in default of this knowledge it may be necessary to tie above and below the swelling, turning the clots, and seeking any artery that may communicate with the sac.

Communications between Veins and Arteries.

These lesions have added an increased interest to the wounds of large vessels. They have been met with in the neck and limbs wherever a large vein accompanies an artery, and there were numerous examples of each of the two classical varieties, namely, varicose aneurysm, and aneurysmal varix. As is well known, the chief point in the diagnosis between them consists in the development of a definite tumour in varicose aneurysm, and the absence of a tumour in aneurysmal varix. In the early stages in which these lesions were seen at the war there were only two symptoms of their presence, though these were striking enough. There was first the impulse and thrill which were felt on palpation, the thrill being most distinct over the seat of communication, but being felt some way down the limb in the course of the artery and vein. It was continuous, being present

throughout the whole of the cardiac cycle, though frequently most pronounced in systole. It ceased on compression of the artery, and returned again when the pressure was relaxed. It was most pronounced on gentle pressure.

The second symptom was the bruit, discernible like the thrill throughout the heart's cycle, and though best heard over the communication, it was traceable almost down to the most distant part of the limb, and also up to the heart in many cases. The bruit could by pressure on the tumour or the communication be confined to the systolic period of the heart's action. The actual noise varied, and was compared in one case to a coarse purr, and in another to the noise of machinery in motion.

As a rule neither the thrill nor bruit were noticed by the patient when the lesion was in the limbs, unless, of course, he touched it with his hand, but when in the neck the bruit was very perceptible, and if the patient lay on the same side as the aneurysm the noise became in some cases distressing.

In those cases that appeared to be true aneurysmal varices the pulse beyond the communication seemed little, if at all, affected as regards volume.

Engorgement of the veins and pulsation in them has been notably absent in the cases seen by us, nor has dilatation of the artery above the communication in the case of aneurysmal varix been noted. Some time must elapse, however, before it can be said that these secondary conditions will not appear. No necessary disability seems to attach to the mere communication between the artery and vein, and such symptoms as are present in some patients are due chiefly, if not entirely, to the aneurysm. We doubt if many men with an aneurysmal varix would notice anything at fault if they did not feel the thrill, although, no doubt, as time went on symptoms would develop.

Treatment of Arterio-Venous Communications.

The immediate treatment of such cases generally resolves itself into the application of the best means for the arrest of hæmorrhage, and in almost all such cases we feel sure that the resolute application of pressure is most likely to yield satisfactory results. In actual practice, however, pressure has sufficed to arrest bleeding from the largest vessels, and we saw two officers wounded at Paardeberg, in whom bleeding from the vessels in the carotid itself was thus arrested. One of those patients told us how the sergeant of his company had, at the risk of his life, knelt over him under fire and held on to the bleeding place for over an hour. This brave fellow certainly saved his officer's life, but unfortunately lost his own two days later in another engagement. In this particular case a definite aneurysmal swelling was present when one of us first saw the patient ten days later, and there were also the characteristic signs of arterio-venous communication, whilst within the next fortnight the aneurysm became much firmer, and the surrounding extravasation cleared up. About six weeks after the injury the aneurysm began to extend and diffuse, and was then treated by Mr Makins, into whose care the patient had passed, by ligature of the common carotid. Now a year later, though there is still a slight thrill, all the tumour has subsided and no symptoms are left.

In our opinion the course followed in this case probably saved the life of this man, for it is most likely that any attempt at primary ligature of the bleeding vessels in a Field Hospital would have proved fatal, and by waiting till the extravasated blood had been absorbed the subsequent operation was much facilitated. It is on such lines, we think, that similar conditions should be treated.

In those cases, however, where a varicose aneurysm is situated in one of the limbs, and is therefore more accessible, the treatment should be more radical. It is

generally advised that both the main artery and the main veins involved should be ligatured above and below, where they enter the sac, but it is our opinion that this method unnecessarily interferes with the venous circulation and unduly endangers the vitality of the limb. We would therefore recommend that the artery only should be tied above and below the aneurysmal sac, and *as close to this as possible*, for there appears to be no reason to anticipate any further trouble merely because the vein is left with an opening into a sac which will soon fill with clot, and further, cases of satisfactory recovery after this treatment have been recorded.

In the performance of this operation it is of the utmost importance that the greatest care should be taken to ensure that the ligatures are really applied, so that no branch is left to communicate with the sac. For if such a vessel is left untied the operation is not likely to prove successful, and thrill or bruit are likely to return very shortly.

As far as aneurysmal varix is concerned the cases are more simple. In many of these there are no such symptoms as to call for operative treatment, and if the latter is required, then the same method as that advocated for cases of varicose aneurysm should be employed.

CHAPTER XI

BULLET WOUNDS OF THE HEAD AND NECK

Wounds of the Head, Neck, and Face.—Wounds of the head still continue to be the most fatal of all injuries received on the battle-field. Although such wounds are more amenable than might be expected to surgical treatment, by reason of the usual absence of the disruptive effect till now attributed to the modern high velocity bullet, it must be remembered that surgery, though it has been able to save life, has failed to restore many patients to their normal physical and mental condition.

Description of Wounds.—A bullet may inflict a simple scalp wound. This may present the characteristic type apertures of entrance and exit; or the wound may be a linear one, the shape naturally depending on the angle at which the bullet impinges, and the curvature of the head at the point struck. Such wounds frequently have a very innocent appearance, and are often as simple as they appear, yet care must be taken that a more serious injury to the underlying cranial vault is not overlooked.

Injury to Bone.—The simplest trauma is that of a linear fissure or crack, with or without depression of one side or the other. Such injuries have been found when least suspected, and when it seemed hard to account for them except on the supposition of a lateral transmission of force, since no bone appeared to lie in the actual axis of flight of the bullet. These fissures are, however, often important

because of the splintering of the internal table that may accompany them.

Gutter Fractures.—When the flight of the bullet approaches more nearly a right angle and the bone of the cranial vault lies directly in its axis, a "gutter fracture" will result. These are much more important than the simple fissured fractures—first, because they were much more common, indeed they formed a very large proportion of all head injuries ; and secondly, because the damage done was much greater.

They present three varieties. In the first, the outer table is broken into various sized fragments along the track of the bullet in such a way that the outer surfaces of the fragments form a very open V, with its apex depressed below the general level of the skull. The length of such a gutter fracture and the amount of depression must of course depend on the angle at which the bullet strikes. The actual number of fragments into which the outer table is split is subject to no definite rule. The inner table is also shattered and split into fragments which are depressed on to the dura mater, but the trauma is usually more extensive here, and the plates of bone detached are often very thin, and extend for a considerable way under the sound outer table, being indeed sometimes so large as to be extracted with difficulty, even after the free removal of bone for that purpose. The edges are thin and knife-like. In some of these cases the scalp is laid open and reveals the depressed bone, or, as in the following case, may conceal a very grave lesion.

W., Trooper, Victorian Mounted Rifles, was wounded near Rensburg by a Mauser bullet, which entered the scalp over the ascending frontal convolution about one inch from the mid-line, and emerged an inch and a half lower down. The entrance wound was an insignificant crack in the scalp, and the exit was a tear about

half an inch in extent. There were no symptoms pointing to a serious lesion, and after two days in the Field Hospital the patient was sent to the base. The wounds were then healed. At the end of the next few days symptoms of intracranial abscess developed, and an operation revealed extensive comminution and depression of the cranial vault, with a wound of the dura mater, and a large fragment of bone lying in an abscess in the cerebral cortex. The patient made an excellent recovery.

The next case, which may be described as *the second variety* of gutter fractures, presented some unusual features, as the outer table had been driven vertically in, and the scalp wound was of unusually large dimensions.

H. J. C., Victorian Mounted Rifles, was shot at Hobkirk's Farm, near Colesberg, on 15th February, and was admitted to the Portland Hospital on 17th February. He was then found to be suffering from an irregular scalp wound over two inches in length, situated across the superior longitudinal sinus at the top of the Rolandic area. The scalp wound was of such a nature that it was thought that the wound had been caused by a shell, and further examination showed that the bone was depressed. The temperature was 101° Fahr., and the patient was unconscious and irritable, and lay curled up on his right side.

Under chloroform it was found that the outer table was depressed for the space of one and a half inches in a remarkable manner. The breadth of the sunken portion was only one-eighth of an inch. The walls were vertical, and the whole appearance suggested that a narrow bar of iron had been laid on the bone, and then forcibly struck by some heavy weight.

A trephine hole was made to one side of the fracture and the depressed bone freely removed. The inner table had suffered much more extensive fracture than the outer, irregular fragments, almost the size of a halfpenny, being broken off and driven inwards, one of

which had torn the dura mater. Lying between one of these fragments and the diploe was a small portion of the mantle of a bullet, thus showing that the injury had been caused by a bullet, and not, as at first supposed, by a shell. It is of course possible that the bullet was an expanding one. The patient steadily improved, and was discharged with the wound healed, and with no symptoms of cerebral disturbance.

A letter, dated from Australia on 14th August 1900, was received from this patient, in which he said that on the way home the wound opened, and discharged five flat flakes of bone, the largest being the size of a farthing. This fact is of interest, we think, in showing that the damage done to the bone by the bullet was even more extensive than it appeared to be at the time. On 23rd October 1900 a further communication from the patient informed us that the wound was again healed and sound, and that he was in perfect health.

The third variety of gutter fractures comprises those in which bone is actually carried away by the bullet, and a large gaping wound is left in which the brain is exposed and lacerated, or may even have suffered some loss of substance.

Such fractures as these are caused by bullets whose line of flight would pass just through the inner table, and which thus encounter a very definite resistance from the bone of the cranial vault, to which they are thus enabled to impart a considerable portion of their energy. It is not surprising that under these conditions the loss of bone should be considerable, and that the fragments flying out as secondary projectiles should cut and tear scalp, dura mater, and brain substance.

The number of fragments that may have to be removed is remarkable, and we have seen a case in which twenty-eight pieces of bone were taken away. Ricochet or distorted bullets are sometimes responsible for the excessive destruction, as in a case related to us by

Dr A. E. Stevens. The patient was a Boer who was shot in the trenches at Paardeberg. The wound commenced just in front of the coronal suture on the right side, and continued backwards, gradually increasing in size until it crossed the lambda, and ended in the occipital bone about $1\frac{1}{2}$ inches behind the superior angle of this bone. The Boer was dead, lying on his back against the back wall of a trench, and just behind the wound was a mushroomed Lee-Metford bullet, which had apparently caused the injury.

Perforating Wounds of the Cranial Cavity.

When the flight of the bullet is such that its axis forms a chord of a circle with the cranial vault, the result is a perforating wound of the cranial cavity. The bone lesion in these cases, as a rule, is less severe than in the tangential wounds, and this is no doubt due to the fact that the bullet impinges on the skull at an angle which more nearly approaches a right angle than in the cases of gutter fracture above described.

The great majority of these wounds are small, round perforations. The entrance and exit apertures are of much the same size, though the exit aperture on the whole is most likely to be the larger, but not with such constancy that it is possible to say, from a mere examination of the wounds, which is the entrance and which the exit aperture. The unsupported table suffers the most. Thus, at the aperture of entrance the inner table will be the most shattered, and at the aperture of exit it will be the outer table that is most affected. At the same time it was not uncommon to find that the external table at the entrance aperture, and the inner table at the exit, were rendered irregular by the raising of small irregular spicules or plates about their margins. The extent of the detached bone in the cases we saw was not great, but was of such extent as to make surgical interference desirable.

Fissures of the bone in these cases were not commonly

extensive, and were either single, multiple, or radiate. As a rule they were not long, and extended for a distance of only an inch or an inch and a half. Occasionally they were much longer, and extended into the base of the skull for a considerable distance. The entrance and exit apertures have been known to be joined by a single simple fissure, even though they were a considerable distance apart, whilst in other cases a line of bone fragments has connected the two apertures, even though the bullet has penetrated the brain beneath, and avoided the cranial vault between the entrance and exit wounds. It may be stated here that the expected disruptive effects of the perfect Mauser bullet have not been seen, the nearest approach to such a condition being multiple fissuring of the vertex and the starting of the sutures, although even this has been rare. On this subject we have had the benefit of the experience of many officers in charge of units and bearer companies, and all those who have kindly given us their opinion agree that they have never seen a case where disruptive or explosive effects on bone in wounds of the cranial cavity could be attributed to the unaltered small-bore bullet.

It can therefore be stated that in cases of bullet wounds of the skull at ranges observed in this war practical experience has not borne out the deductions of experiments. There is, however, some evidence that setting-up bullets do work dreadful havoc on the skull, and, in addition, the possible effects of distorted bullets and of bullets rotating on a transverse axis must be remembered.

Wounds of the Brain.

In the case of tangential wounds the worst injury to the brain is found in those cases of gutter fractures in which the bone is blown out, for then, in addition to the bullet we have to deal with the numerous torn fragments of the bony covering which are driven through or into the cerebral cortex. The resulting actual loss of

substance is often considerable, and in addition to this there is much destruction of brain substance from laceration and hæmorrhage. Passing from the more severe to the milder cases, we have a gradation from a gaping wound of the cortex to a slight tear of the dura mater, or even a simple injury to the bone without damage to the underlying parts.

In the case of perforating wounds the actual damage done to the brain matter is liable to great variation. The wound may be a simple track showing some small points of blood extravasation in its neighbourhood, or the brain matter may be extremely torn, lacerated, or reduced to a hæmorrhagic pulp. In addition to the actual damage done by the bullet at the moment of its flight through the brain, the subsequent effects of hæmorrhage from torn vessels must be remembered. This bleeding, as in all head injuries, may be meningeal or interstitial, and the latter may be said to simply intensify the effect of the projectile. The continuance of this bleeding produces the hæmorrhagic pulp which is such a striking phenomenon in certain cases, and by it the brain matter is brought into a condition of disintegration from which no recovery is to be expected, and to which a fatal issue almost invariably attaches. The meningeal hæmorrhage may be free, and may quickly produce symptoms of compression, or these may appear later, but on the whole we should say that cases of this kind have been decidedly rare. Ventricular hæmorrhage has also been observed as the cause of death.

The amount of disturbance produced by the small calibre bullet has been very various. Wounds near the base produced more marked symptoms than those nearer the vertex, and patients so wounded were, as a rule, rendered unconscious, and continued so till they died. These patients presented the symptoms usually associated with fracture of the base as seen in civil practice.

When the more superficial parts of the brain were involved some patients were stunned and at once lost

consciousness; other patients said that they remembered receiving the wound and performing some act before they fell down and remembered no more. The length of coma in those cases that recovered varied from a few hours to several days. On the other hand, very severe complications, such as hemiplegia, have been caused, and yet the patient has shown no sign of loss of consciousness.

The higher centres also have been affected (*British Medical Journal*, 26th July 1900). Thus, in a case seen by one of us, a soldier was hit over the outer angle of the left eye, and the bullet emerged one inch to the left of the external occipital protuberance. Both wounds were small, and both healed readily, but the patient was unconscious for two or three weeks, and when he came to his senses all remembrance of the accident was lost, and, in addition, memory for past events was also lost, so that the patient, six months afterwards, had no memory of his own past life and no knowledge of the appearance of his wife. He was, however, in excellent health and quite bright and alert. In addition to the loss of memory he suffered from hemianopsia due to the injury to the occipital lobe.

A few cases have occurred in which mania replaced coma, and the recipient of the wound, instead of lying quiet, insisted on walking or running about, shouting and performing other unaccountable actions.

Loss of sight has been noted as the consequence of a wound in which no structure or centre connected with that sense has apparently been injured. The return of vision in these cases seemed to show that its loss, in some instances at any rate, was due to commotion or vibration set up in the brain by the blow or passage of the bullet.

The whole question of the distant effect on brain matter of a high velocity bullet is very complex, and we believe that so far no definite statement can be made. It is only by post-mortem records that the matter can be really elucidated, and these have been few and far between. In addition to this the range and velocity of the bullet have

been unknown, and a rough computation has been all that has been arrived at in most cases, whilst another disturbing factor is the difference in calibre of the small-bore bullets used.

Influence of Range.—It is practically certain that all penetrating wounds of the brain at short range are fatal, and we believe that practically all the patients who have recovered from such injuries have been shot at long ranges.

Influence of Direction and Position.—Certain general conclusions can be arrived at from the situation and direction of head wounds, which are of use in estimating the gravity of the case and in giving a prognosis. Putting aside tangential wounds, whose gravity largely depends on their extent, it may be said that a longitudinal wound is more serious than a transverse one, and that a transverse wound in the posterior part of the brain is very much more serious than one in the anterior part. Both longitudinal and transverse wounds become more serious as they approach the base. The most fatal wound is one that traverses the brain in an antero-posterior direction near the base, and the least serious is one that traverses the frontal lobes from side to side towards the anterior superior surfaces.

Wounds of the frontal lobes have furnished some of the most remarkable recoveries from head injuries. The two following will serve as examples :—

F. A. H. was a railway man, and took part in the defence of Mafeking ; towards the end of the siege he was shot through both frontal lobes. He was unconscious for a time, but beyond this presented no symptoms. In July one of us saw him at work as a guard of a train. He was, he said, in perfect health, and as well able to do his work as ever.

The second case was that of a private in the Highland Brigade, who was shot through the frontal lobes in one of the battles of Methuen's advance to Kimberley. He was sent back to Jacobsdal, and so far recovered that he re-joined his regiment, and it was not until after a very

arduous march and two days' fighting that he complained of headache, and was then sent for light duty at the base.

If he ever lost consciousness at all it was only for a short time, for he was able to walk back to the dressing station, and to get into the ox-waggon with a little help.

In contrast to these two the following is interesting :—

A. B., æt. 21, was shot in the back of the head just below the external occipital protuberance on the right side, and the bullet emerged just above the left orbit, into which it caused a hæmorrhage. This man lost consciousness at once, and remained in a state of absolute coma for ten days, when he died.

His condition was exactly like that of a patient with a severe fracture of the base of the skull, and from first to last he showed no sign of recovery.

Localising Symptoms.—Local symptoms consisted of irritative or paralytic phenomena, and of these the latter were by far the most common, and resulted from injury to, or destruction of, both the motor and sensory cortex or underlying fibres. The irritative motor phenomena have shown themselves soon after the injury, and have usually ceased with operation, but have again appeared after some time has elapsed, and when the wound has healed. Tangential wounds over, or perforating wounds through, motor areas have been followed by paresis or paralysis; and tangential wounds, as would be expected, have more often been combined with impairment of sensation than have the perforating wounds. The paralysis has been usually of the monoplegic or hemiplegic type, and its severity has been subject to great variation.

The paralysis in cases of tangential wounds has more accurately corresponded to what would have been expected from their situation than it has in perforating wounds, when it has been somewhat difficult to explain the symptoms from a study of the direction of the wounds. This is possibly to be accounted for by the so-called commotion of the brain

matter by the bullet, or by a hæmorrhage causing destruction of tissue. In many cases the paralysis or paresis have become permanent.

When the lesions have involved the left motor cortex in its lower part the paralysis has been combined with aphasia, agraphia, and alexia, but whether the third frontal or superior temporo-sphenoidal convolution was at fault it has been difficult to say. The aphasia has cleared up before the paralysis of the arm or the leg, and on the whole the leg has cleared up before or gained more power than the arm. The amount of paresis left has certainly varied very much, but the good effect of early operation was seen distinctly in the case of an officer who was hit over the left motor area by a tangential shot passing from above down. From this patient no fewer than twenty-eight pieces of bone were removed, and within twelve hours of the operation the speech centre was nearly normal, and great improvement had taken place in the paralysed arm and leg. This man improved up to a certain point, but was seen later at the base still suffering from much cerebral irritation, and liable to epileptiform seizures.

Some of the most interesting local lesions in connection with the sensory cortex were seen in wounds of the occipital lobe or its neighbourhood. The following is a case in point:—

A. J. was wounded in the head. The bullet entered one inch in front of the external occipital protuberance, and, after penetrating the brain, lodged in the posterior part of the left mastoid process, the outer wall of which was forced out in front of it. There was slight weakness of the right arm, and the sight was lost in the right halves of both fields of vision. The weakness of the arm improved, but the state of the fields of vision showed no alteration up to the time of the patient leaving for home some months later.

Transverse lesions in the occipital region have produced the same symptoms, and in some cases with signs of the involvement of the centres for vision on both sides.

A definite prognosis in the matter of paralysis or paresis is certainly hard to give, but we are not inclined to take too gloomy a view until a considerable time has elapsed, as we have seen cases still improving many months after the original wound.

The following is a typical example :—An officer was struck on the vertex by a shrapnel bullet, which fractured the skull and rendered him unconscious for a short time. As soon as he came to his senses he found that he had lost all power in the legs, and for several weeks they remained quite limp, and he could not move them. For three months he remained a prisoner ; but when we saw him four months after the injury he could walk, and was daily improving in strength.

One of the most remarkable of these cases was that of a child under the care of Dr Ashe at Kimberley. The boy had been shot, at a range of at least a mile, by a bullet which entered three inches above the right eyebrow, and emerged at the vertex, two inches behind and to the left of the Rolandic area. He at once completely lost power in his right arm and in both legs, but his general condition was not at all serious in proportion to the paralysis. When one of us saw him some five weeks later, he was beginning to improve, and could move the arm and left leg a little, but could not move the right leg at all. Nearly a year after the injury Dr Ashe wrote : " I found him heaving stones with his right hand with force and precision at a stray fowl. The right arm and left leg have recovered perfectly, but the right leg not so well. There is some awkwardness in its movements, but he can stand all his weight on it, and it is improving. There is increased knee-jerk and ankle clonus, but the boy is well enough to play football, and suffers very little inconvenience."

No operation was performed in this case, and it thus happened that a long antero-posterior wound traversing a most important part of his brain was recovered from

without surgical interference, and with only such paresis as seemed likely to pass away in time. It is to be noted that this was a very long-range wound.

Complications.—Septic contamination was as unusual in head wounds as in other parts of the body, and when it did occur, presented no features of special interest. As is well known, abscess may follow weeks or months after compound fracture, and a good example of this is quoted by Mr Ballance of Norwich in the *British Medical Journal*, 6th October 1900. In this case a man received an antero-posterior wound of the vertex, the exit being two inches above and to the right of the external occipital protuberance, and the entrance at the inner angle of the right eyebrow. Immediate complete left hemiplegia followed and remained permanent. The patient, with the exception of the paralysis, recovered entirely, and continued well for three months, when the pulse dropped to 54, and optic neuritis, external strabismus, and a dilated right pupil supervened. An abscess in the occipital lobe was drained, but the patient died, and at the post-mortem examination an unopened abscess in the parietal lobe was found, and also a patch of softening at the genu of the internal capsule.

In addition to attacks of Jacksonian epilepsy which occur at the time of the injury, irritative phenomena are also seen at a later period, and we believe that these will be found to be more common in the tangential wound with laceration of the brain than in the perforating lesions. In the former it must happen that the brain, dura mater, and scalp become intimately adherent and thickened, so that the conditions are present which are often found to accompany irritative phenomena. At the same time it must be remembered that persons who have received such wounds are likely to have functional fits, and care must be exercised to distinguish functional from organic disturbances. In addition to definite physical infirmities, such as paralysis, men who have been the subjects of brain injury

sometimes undergo a very definite mental deterioration, losing much mental activity and spontaneity. It certainly is a sad sight to see how little may remain to characterise a man who was once a smart and intelligent soldier.

Treatment of Wounds of the Head.

No scalp wound, however insignificant it may appear, should be treated lightly. Care must be taken that such trivial looking wounds do not cover a much more serious condition of the underlying bone than would seem probable. For this purpose the wound must be thoroughly explored, and if necessary enlarged, so that no possible fissure or depressed bone may escape notice. As will be seen by a perusal of the case quoted on page 217, omission to fully recognise this fact led to serious consequences.

The treatment of tangential wounds is obvious. Loose fragments must be removed, and the under edges of the bone carefully inspected for plates detached from the inner table, which may be driven out of sight under the external table. If the brain is exposed, this must be looked over for spicules, and, lastly, the edges of the bone rendered as far as possible smooth by removal of jagged surfaces. The whole wound, of course, should be carefully cleaned of all extraneous matter by washing and clipping away of dirty and soiled tissue. The edges are then to be brought together as far as is consistent with the drainage required.

All perforating wounds should be subjected to operation, whether symptoms are present or not, and a disc of bone should be removed at both the wounds of entrance and exit, because, as was said on page 219, it is seen that it is not always possible to distinguish one aperture from the other, and that even at the exit wound the inner table may suffer damage. This is necessary because of the plate-like fragments detached from the inner table. The actual method employed for such removal is immaterial, but care must be taken that sufficient bone is taken away so that no

fragments are overlooked and left behind. Any exploration of the track of the bullet in the brain, except under special circumstances, is to be deprecated.

The treatment advocated for such wounds as have been described immediately above will not be disputed by any surgeon, but when linear fissures and slight gutter fracture are reviewed opinions may differ. We would say without hesitation that all depressions, however slight and trivial looking, should be thoroughly explored, as it is impossible for any one to say what the underlying damage is. As regards simple linear fissures, a definite rule cannot be laid down, and the question of operation must be settled by the condition of the patient and the presence or absence of irritative, paralytic, or compression symptoms. Our own opinion is that it is better to operate when in doubt, than to adopt an expectant attitude. The actual site of operation may have to be determined by the symptoms present, but in the absence of focal lesions it must always be right to operate wherever there is injury of the bone. It must, however, be borne in mind that hæmorrhage may occur, and may continue so as to cause symptoms either by compression or laceration of the brain.

We are inclined to think that in the wounds with loss of bone and injury to the dura and brain substance the use of a thin platinum plate would possibly ameliorate some of the later complications, by preventing the blending together of scalp, dura mater, and brain. The foil used can be so thin as to be cut with scissors, and shaped to the wound, but of sufficient thickness to bear the weight of the adjacent scalp. Whether this can be successfully applied when some time has elapsed, and the patient comes to seek advice for recurring fits, is open to doubt, as by that time all the tissues are intimately blended. Beyond this, the treatment of complications of head injuries, such as septic conditions and abscess formation, require no special mention, as they fall under the ordinary rules of surgery.

Wounds of the Eye and Orbit.—In addition to the

hemianopsia as a result of lesions of the occipital cortex, and functional temporary blindness from commotion of the brain substance, there have been many local injuries resulting in more or less complete blindness. Lesions of the frontal lobes toward their base have been the cause of complete loss of sight in one or both eyes from injury or section of the optic nerves. In addition to this, optic atrophy has resulted from wounds which could not in themselves have directly damaged the optic nerves or the globe proper, and this atrophy is most easily accounted for by supposing that fissures extended into the orbital plates with resulting damage to the optic nerve.

The globe of the eye has been absolutely disorganised by direct injury from the bullet, either with a transverse or vertical direction. In other cases the bullet has passed through the orbit without any obvious direct injury to the globe, any intraocular extravasation of blood, or detachment of retina, yet blindness has followed, though unaccompanied by any ophthalmoscopic change. There is an inclination to explain this by the theory of lateral transmission of force, which would be accentuated in the small, practically closed, space of the orbit. It should be remembered, however, that this is a theory at present, and not borne out to any extent by experience. Abrasions and wounds of the cornea and sclerotic have also occurred from fragments of bullets or rocks.

Aural Wounds.—Loss of hearing has resulted in some cases as a direct consequence of the transit of a bullet through some part of the auditory apparatus, as when a projectile passes through the temporal region, but may also result indirectly from the extension of fissures into the petrous bone, causing injury to the auditory nerve. Such wounds have been followed by bleeding from the meatus, and escape of cerebro-spinal fluid as in cases of fractured base, and, as here, there is little scope for active surgical interference.

Wounds of the Olfactory Organs.—These have, as a rule,

been complications of wounds of the anterior fossa and frontal lobes, or of the orbital cavities.

Wounds of the Face.—These wounds have not presented many features of interest. The face bones, with the exception of the lower jaw, from their thinness and fragile structure, have offered little or no resistance to the projectiles, and have therefore often escaped with but little injury. It may be said that the face bones have been perforated in every direction, and have caused only very slight complications of the wounds.

Wounds of the alveolar margins are of more importance, because the loss of the teeth means that the soldier is not likely to be of much service at the front, on account of his inability to masticate tough meat and hard biscuit. Such injuries result in very nasty, jagged, and often evil-smelling wounds of the oral cavity. The teeth are either knocked out or broken across, the soft tissues being torn and lacerated to a considerable extent. The wounds often take a long time in healing, and this is partly due to superficial necrosis of the jaw.

In one case mentioned to us by Mr Gordon Watson, where an officer was struck in the lower jaw at close range, the resulting injury was terrible, most of the bone being carried away except a portion attached to each condyle. It was uncertain whether the injury was caused by an expanding bullet or not, but even when the dense structure of this bone is remembered, it is difficult to account for so extensive an injury even if an expanding bullet was used.

The ease with which the modern bullet will penetrate unresisting structures was shown in the case of an office who was shot through the alæ of the nose. The projectile passed simply and cleanly through this structure, and made two small holes just as if the part had been firm and well supported.

Wounds of the Neck.

Here again the chief interest centres in the nerves and blood-vessels, and their injuries are dealt with elsewhere. This region has supplied numberless cases of wonderful escapes—perhaps more so than any other part of the body when all the great vessels and nerves are remembered—and we have seen transverse wounds whose tracks lay just across the front of the spinal column presenting absolutely no special symptoms at all.

Even wounds of the trachea and larynx have exhibited very mild symptoms, considering the nature of the part struck.

One officer we saw was wounded by a Mauser bullet which passed transversely through the thyroid cartilage just above the vocal cords. This resulted in the immediate coughing up of some blood, and a feeling of suffocation which did not, however, last long. There was afterwards loss of voice for some days, and then a period in which the voice was hoarse and phonation painful, but eventually complete recovery took place.

In another case the trachea was opened just below the cricoid cartilage by a transverse bullet wound. Very little trouble resulted from this tracheotomy, and the patient fully recovered and returned to the front.

The mildness of the symptoms is really very remarkable when one remembers the very alarming, if not dangerous, symptoms that are seen to follow a blow on the trachea or larynx, even without any fracture of the sustaining cartilage.

The case of the larynx wound might well be quoted to show how local the effects of a small-bore projectile may be.

CHAPTER XII

INJURIES OF THE SPINE

THERE is but little to say about injuries of the spine and spinal cord by bullets which might not be said of injuries seen in civilian hospitals at home.

It seems certain that the bodies of the vertebræ may be shot through and simply perforated by "perfect" bullets without there being any evidence of injury to the spinal column by the development of any special symptoms of weakness or pain. We saw several patients in whom it appeared probable that such an injury had occurred, and in one of our patients, who was shot from side to side through the lumbar region without any special symptoms, it was practically certain that the track of the bullet passed through the body of the second lumbar vertebra.

Here is another more definite and interesting case:—

A private in the Guards was wounded at the battle of Magersfontein by a bullet which knocked out the right upper central incisor. The man fell, and afterwards said he must have hurt his arm in falling—his own story being believed, especially as there was no evident bullet wound. Amidst the pressure caused by the crowds of badly wounded men, this patient, who was supposed to have only bruised his shoulder and leg, escaped further notice until he was sent into the Portland Hospital a little time after the injury. He was then found to have a good deal of occipital headache, almost complete paralysis of

the right arm without anæsthesia, and rigidity and weakness of both legs, whilst further examination showed that the bullet that had knocked out his tooth had passed through the soft palate and emerged in the sub-occipital region, to the right of the atlas. Of all this the patient was quite ignorant, and it then appeared that he had become unconscious at the time he was shot, and that, as no wound was seen, it was assumed that he had fallen and hurt his head and arm. He remained in hospital several weeks, and improved considerably, but when he left he still had weakness and rigidity of the legs, with ankle clonus and increased knee-jerk, and his arm was still weak, the extensors of the forearm and wrist being almost completely paralysed.

In other cases the passage of bullets near to the spinal cord has been productive of transient symptoms of contusion of the cord. Thus, an officer was shot at short range (200 yards) by a bullet which passed across the upper dorsal spine, entering at the outer border of one scapula and leaving the body below and to the outer side of the angle of the scapula on the other side. He immediately fell and lost all use in both his arms, and told us that for three or four hours he could hardly move them at all, and that they felt numbed and tingling all over; his legs were comparatively little affected. After about five or six hours he regained power in his arms, and within eighteen hours of injury was able to walk twelve miles, the arms quite recovering a day later.

In another officer, a bullet entered his neck three inches above the clavicle on the right side, and at the edge of the trapezius. It passed downwards and to the left, and emerged at the angle of the left scapula. Immediate paraplegia resulted, and there was temporary loss of consciousness. For six weeks there was no return of power or of sensation in the lower extremities, and a bed-sore formed on the buttock; the bladder and rectum, however, escaped paralysis. Improvement now commenced, and

sensation returned, except for the perception of heat and cold, so that five months after the injury the patient could move his legs freely in every direction, though as yet he could not walk. There was then also some rigidity, with clonus and increased knee-jerk. A good prognosis was given.

In the next case the injury was more severe and the symptoms more abiding.

Major H. was shot through the cervical spine whilst standing on a kopje, and immediately fell, with complete loss of power in his arms and legs.

The bullet entered the neck about two inches below the left mastoid process, and emerged at the outer edge of the right scapula. He was uncertain as to how much time elapsed before he could use his legs at all, but within a few days, at any rate, there was some return of power. When he arrived at the Base Hospital he could not walk, and could hardly use his arms at all, and the large muscles of the left side of his neck and shoulder were paralysed. When he arrived in England, two months after the wound, he came under the care of Sir Thomas Smith and Dr C. Morris, who found him hardly able to walk, with muscles exceedingly wasted in both upper and lower extremities, and with almost complete loss of power in the hands and arms. In spite of this, however, and in spite of his muscles becoming actually weaker for two months after his arrival in England, his subsequent improvement was steady and continuous. Ultimately recovery was so complete that the patient was able to rejoin his regiment at the front within a year of being shot, and after having seemed at one time to be permanently crippled. He still had some dropping of the left shoulder and weakness of its muscles due to the injury to his cervical nerves.

It would seem that in such cases as these there has been a contusion of the cord by the passing of a bullet in close proximity to its membranes, but without passing through the cord or the membranes themselves, or causing hæmorrhage into the cord.

That this may actually happen is clearly proved by a specimen in the possession of Mr Lenthal Cheatle, who has very kindly supplied us with the accompanying illustration. In this case, the passage of a bullet through the body of the tenth dorsal vertebra, comminuting the bone but not opening the spinal canal, was followed by complete paralysis of all the parts below the seat of injury, and by the usual bladder and rectal troubles consequent on this condition. The patient died from the effects of the injury to his cord after an interval of four weeks, and the post-mortem examination showed that there was no hæmorrhage into the spinal canal or the meninges, nor any evidence to the naked eye of a cord lesion. After hardening the cord in spirit, sections showed no interstitial hæmorrhage or softening, and a microscopical examination revealed no degenerative changes in the nervous tissue. It would appear, therefore, that here was a case in which, had the man been able to survive the bladder complications and the bed-sores, the injury to his nervous tissue might have been recovered from ; and viewed in the light of this post-mortem examination, it would seem that a contusion without evident lesion of the tissues of the cord occurred in the case of Major H. just recorded, for had there been serious damage to the nerve cells or fibres in the cord, it is evident that his recovery could not have occurred as quickly or completely as was actually the case. (See Plate XLIV.)

In another man, seen by one of us at Modder River with Mr Cheatle, the patient died several weeks after a Martini wound of the dorsal spine, causing complete paraplegia, with bed-sores and cystitis. The post-mortem examination by Mr Cheatle showed that the bullet had passed through the laminæ of the seventh dorsal vertebra without injuring the cord or its membranes, and a microscopical examination demonstrated that there was no evident lesion of the cells or fibres of the cord. In both these cases the general condition of the patient was such

BULLET WOUND OF THE BODIES OF TWO DORSAL VERTEBRÆ, without evident Injury to the Spinal Cord, but causing complete Paraplegia and Death.

[*To face page* 236.

BULLET WOUND OF DORSAL LAMINÆ, without evident Injury to the Spinal Cord, but causing complete Paraplegia and Death.

[*To face page* 237.

as to make it seem certain that there was a total transverse lesion of the cord, for there was complete flaccid paralysis with loss of the deep reflexes and paralysis of the sphincters. (See Plate XLV.)

These cases of cord injury may indeed be compared with those contusions of the nerves of the extremities which may cause a complete temporary paralysis, although an exploratory operation reveals no sign of injury to the affected nerve. It is certainly a most interesting fact that the functions of the cord can be completely arrested without any evidence of disintegration of its tissue, and indicates that prognosis in such cases must necessarily be cautious.

In some patients where the bullet has passed through the spinal canal, the cord has seemed to be injured by the fragments of bone projected by the bullet rather than by the bullet itself.

In the case of an officer who died in the Portland Hospital, an injury to the cord was apparently due to both the passing of the bullet and of pieces of bone through a part of the cord, and it is quite possible that in some cases fragments of bone might remain pressing upon the cord and requiring removal by operation.

It is, however, evident that, if the mere passage of a bullet near to the cord can completely arrest its function, the direct injury by fragments of bone or of bullets must so damage the delicate nervous tissue that the mere removal of the cause of the pressure is insufficient to alleviate conditions which are almost certain to be associated with irrecoverable injury to the cord.

Thus, in the accompanying Plate showing a bullet lying so as to project base first through the membranes and to press upon the cord, it would seem at first sight that operation might have removed the pressure and saved the patient. But an examination of the cord itself shows that operation would really have been quite useless, for the impact of the bullet has so damaged the adjacent cord that

it is completely pulped for an inch or more at the seat of injury. (See Plate XLVI.)

For this specimen also we are much indebted to Mr Lenthal Cheatle.

In most cases where the cord has been injured by a bullet it has been practically severed at the point struck, and this wound and the resulting hæmorrhage combined usually result in the destruction of all the nervous tissue over a length of half an inch to an inch. In all such cases there is necessarily a complete and permanent paralysis, with loss of knee-jerks and flaccidity of the paralysed limbs, and there is no hope that any improvement will take place.

Such cases are amongst the very saddest that occur, for the patients are usually young, robust, and in vigorous health, and it is sad to see them dying day by day, without being able to give them any material help.

They are also subject to the worst complications of spinal injury on account of the necessarily long delay that so often follows a battle before the most helpless wounded can be thoroughly attended to. The urine is in such cases retained perhaps for a day or more, and severe cystitis develops early, and is followed in many cases by suppurative nephritis. The inability to provide a comfortable bed and to wash and keep clean from fæcal matter the skin of the buttocks and adjacent parts, causes the early development of the most horrible bed-sores, so that in a very few days the condition of a man previously in rude health is most painful to contemplate. Some of these patients had but little pain, but others suffered most acutely, so that in some few it was almost impossible to move the bed or the patient without causing intense agony. In one case that we saw frequently, the suffering on movement was so great that chloroform had to be daily administered to enable the bed-sores to be dressed and the patient washed.

In such cases the patient is fortunate in whom the bullet has severed his cord high up, and has interfered

Portion of Spinal Column, showing a lodged Bullet which had divided the Spinal Cord.

[*To face page* 238.

with thoracic respiration, for in that case life is not likely to be prolonged beyond a week or ten days, and may fortunately be terminated earlier without much suffering. Thus, an officer shot through the right side of the chest and the dorsal spine died quite suddenly of syncope on the sixth day, the heart being unable to continue its work with paralysed intercostals and a large hæmothorax, and the patient having but little dyspnœa before the final attack, which was over in less than a minute.

Beyond careful nursing there is little to be done for most of the bullet wounds which are complicated by injuries to the spinal cord, and it can only be in very exceptional instances that laminectomy can be of any service.

CHAPTER XIII

INJURIES OF NERVES

INJURIES of nerves have always been very common in war, and, in the war in South Africa, where the passage of a bullet through the soft tissues often left but little external evidence of injury, the symptoms of paralysis of muscles and of alterations in sensation were all the more noticeable because the limb was often perfectly well in a week or two with the exception of such troubles.

Much attention has therefore been directed to these conditions, and it seems to us that there has consequently been rather a tendency to exaggerate the frequency with which they occurred.

Symptoms of Section of a Nerve.—The two chief symptoms which indicate at once that one of the nerves of the extremities has been injured are loss of power and loss of sensation.

Loss of Power.—The muscles supplied by the divided nerve are immediately paralysed, and remain in this condition so long as the nerve remains ununited. Later, they rapidly waste and degenerate. This atrophy is much more rapid and complete than can be accounted for by inability to use the affected muscles, and proceeds so quickly that within three or four months but little of the muscular tissue remains. The atrophy, moreover, affects not only the bulk of the muscle, but causes it also to shrink in length, and, by so shortening, to interfere with the action of other muscles, and to produce deformity.

If the condition of the paralysed muscle be examined electrically, further evidence may be obtained, which, in doubtful cases, will greatly aid diagnosis. Within twenty-four hours of the nerve section Faradic irritability begins to diminish, and within four or five days is completely lost, so that even the strongest currents will produce no contraction. It is pretty certain that this loss of excitability is due to the destruction of the motor nerve fibres.

The galvanic current, which acts more directly on the muscle substance itself, does not at first appear to lose its effect, for during the two or three days succeeding the injury, the galvanic irritability of the muscles seems to be actually increased.

After this time, however, muscular contractions grow more feeble, and in the course of about two or three months gradually disappear. It is during this period of diminishing galvanic irritability that the "reaction of degeneration" becomes marked. Normally, the kathodic closure contraction of a healthy muscle is greater than the anodic closure contraction. After nerve section, when the muscle is degenerating, the anodic closure contraction first becomes equal to, and then greater than, the kathodic: a reaction which indicates degeneration of muscle and nerve, and is, therefore, named the "reaction of degeneration." It is strange that after union of a divided nerve has taken place, voluntary power returns many months before the muscles show any reaction to either the galvanic or Faradic currents.

Loss of Sensation.—When a nerve containing sensory fibres is divided, the patient is usually almost at once conscious of the numbness of the skin area supplied by the severed nerve. In those cases, however, where the nerve lesion is only a small part of a serious laceration of the limb, the loss of sensation often passes unnoticed, on account of the pain and shock accompanying such an accident, and thus, unless sought for, this evidence of

nerve injury may remain unrecognised. In most cases complete anæsthesia of at least some of the skin results, and this is always the case when a nerve of considerable size is cut across; but in those cutaneous areas, where more than one nerve is distributed, as on the ring finger, more or less sensibility may persist.

Even in these cases, however, the patient is conscious that sensibility is greatly impaired, and although the sense of touch may be retained to some slight extent, sensibility to pain and to heat and cold are almost always lost. At the edge of the affected skin area the line dividing anæsthetic parts from healthy skin is usually not very sharply marked, and an area of impaired sensibility is generally to be found.

The skin is liable to be altered in various ways. It usually becomes smoother than is natural, and occasionally, in addition, shiny and glistening, the papillæ appearing to be smoothed out. Eruptions of eczema, herpes, or acne may result, and occasionally ulcers appear in the anæsthetic area.

These are frequently due to injury of some kind or another, which, on account of its painlessness, has passed unnoticed by the patient. Thus, an anæsthetic finger may be burnt or cut without the knowledge of the patient, and the resulting sore is slow to heal, partly because of the deficient nerve supply, and partly also because, on account of its painlessness, the part is often insufficiently protected. More rarely nerve injuries are followed by gangrene of the pulps of the fingers or toes, and occasionally of a whole digit. Painless whitlows, with superficial collections of pus, sometimes develop, and from these a slow form of ulceration occasionally extends. These so-called "trophic" lesions were rarely met with in South Africa, and for the reason, we believe, that complete section of nerves was much more rare than partial division.

Shock.—We did not find that gunshot injuries of nerves were associated with any special shock, and the

experience of Weir-Mitchell, who found that of fifty-six men with wounds of nerves ten fell insensible at the moment of injury, was not at all confirmed by us. We did not indeed obtain a history of the most transient insensibility in any of the seventy or eighty cases we saw at different times.

Pain was sometimes severe at the time of the infliction of the blow, but was not by any means invariably complained of, and in not a few cases some time elapsed before the evidence of nerve injury attracted the attention of either the surgeon or the patient.

Pain.—It will be remembered by all surgeons that Dr Weir-Mitchell published a most remarkable and instructive book on the gunshot injuries of nerves which he had observed in the American Civil War, and it will also be remembered by many that he drew especial attention to the severe pain, often of a burning character, which accompanied many of these lesions. We, who were familiar with the nerve injuries of civil practice, were naturally much interested to observe whether the very severe burning pain described by Weir-Mitchell was specially common in cases of bullet wounds, for we had seen but little in our hospital experience in London of what he described as "causalgia," and of which he writes as follows :—

"In our early experience of nerve wounds, we met with a small number of men who were suffering from a pain which they described as a 'burning,' or as 'mustard red-hot,' or as a 'red-hot file' rasping the skin. In all of these patients, and in many later cases, this pain was an associate of the glossy skin previously described. In fact this state of skin never existed without burning pain. Recently we have seen numbers of men who had burning pain without glossy skin, and in some we have seen this latter condition commencing. The burning comes first, the visible skin-change afterwards; but in no case of great depravity in the nutrient condition of the skin have we

failed to meet with it, and that in its forms of almost unendurable anguish.

"Its intensity varies from the most trivial burning to a state of torture, which can hardly be credited, but which reacts on the whole economy, until the general health is seriously affected. The part itself is not alone subject to an intense burning sensation, but becomes exquisitely hyperæsthetic, so that a touch or a tap of the finger increases the pain. Exposure to the air is avoided by the patient with a care which seems absurd, and most of the bad cases keep the hand constantly wet, finding relief in the moisture rather than in the coolness of the application. Two of these sufferers carried a bottle of water and a sponge, and never permitted the part to become dry for a moment. As the pain increases, the general sympathy becomes more marked.

"The temper changes and grows irritable, the face becomes anxious, and has a look of weariness and suffering. The sleep is restless and the constitutional condition, reacting on the wounded limb, exasperates the hyperæsthetic state, so that the rattling of a newspaper, a breath of air, the step of another across the ward, the vibrations caused by a military band, or the shock of the feet in walking, gives rise to increase of pain. At last the patient grows hysterical, if we may use the only term which describes the fact."

Now it may be said at once that these violent and distressing symptoms are very rarely met with in the present day in cases of nerve injuries, in either civil practice or military experience, and that the symptoms of nerve injuries caused by bullet wounds do not in our opinion differ materially from the symptoms of nerve injuries due to broken glass or cutting instruments. We think that the explanation is possibly to be found in the very different conditions resulting from antiseptic treatment, and we believe that the symptoms described by Weir-Mitchell might be those of a septic and possibly

spreading neuritis. On the other hand, it seems that in some of his patients at least there was a good deal of functional disturbance, and some of the cases detailed are like those of men suffering from neurasthenia and its complications.

We do not deny that a good deal of severe pain, and sometimes of a burning character, is met with complicating nerve wounds, but we have not seen it in the severe form alluded to by Weir-Mitchell. In our experience also the greatest pain was complained of immediately or soon after the injury, and not late after trophic disturbances had developed.

One of the patients who complained most of burning pain was a Boer prisoner at Wynberg, who had been shot through the forearm and had evidently had his median nerve injured. He always kept the hand carefully wrapped up and was very disinclined to uncover it. His fingers were habitually flexed, and he was very loth to move them, as he said it made the pain worse.

In other cases also there has been some complaint of burning pain, but we have never seen it in the acute form just alluded to. "Aching pain," "a feeling of numbness," "a feeling of weight," were the common complaints, and the amount that men suffered in one way or another necessarily varied greatly.

Contusion and Partial Division of Nerves.—The loss of motion and of sensation common to all nerve injuries was, of course, evident in the cases we observed, but, as in many nerve injuries observed in civilian practice, when nerves have been contused, the symptoms found directly after the injury were often misleading as to the extent of the damage done.

It must be realised that with small bullets, such as the Mauser and Lee-Metford, contusion of nerves and partial severance are infinitely more common than complete division of them, and it is further very important to note that no value can be attached to loss of sensation or of motion during the first few hours or days succeeding the injury, for

in many cases an apparently complete paralysis rapidly passes away, and in many others improves to a quite remarkable extent.

In the next place it must be noted that where after some weeks there is still an apparently complete paralysis, careful examination will show that the retention of power and of good sensation in some parts renders it certain that the nerve is not really divided, and it must be clearly borne in mind that a mere contusion of a nerve may cause a complete paralysis of all muscles supplied by it for at least a couple of months. These facts were often insufficiently appreciated both in South Africa and in England, and there was consequently a tendency to advise exploratory operations in cases where either the symptoms of complete division were not present, or where no sufficient time has been allowed to permit of recovery from contusion.

The following is a typical case illustrating how that which at first sight appeared to be an injury involving many cords of the brachial plexus was subsequently found to be much more limited.

C. S., a Yeoman, was shot whilst lying down firing on 20th July. The bullet entered just above the centre of the left clavicle, and passed out behind the deltoid in the posterior axillary fold. He at once felt all his forearm and hand become numb and powerless. It remained in this condition for four days, and then, first his hand improved, and afterwards, as weeks went by, the forearm got better. In October, however, he was still unable to flex the forearm, and then power began to return here also, so that by the middle of November muscular power had quite returned in all the muscles except in the deltoid, supinator longus, and part of the pectoralis major.

In all cases of nerve contusion it is to be remembered that a careful examination will often result in the discovery that there is retention of a good deal of natural sensation although muscles seem to be paralysed, and this retention of sensation will often supply the explanation of the real

nature of the case. In contusions also there is none of the rapid wasting of muscles so characteristic of nerve section, and of course, if examined electrically, such muscles will show no reaction of regeneration, but merely a diminished sensitiveness to galvanic currents.

The partial division of nerves may well be considered together with the subject of contusion, for in many cases of contusion there is some rupture of the axis cylinders, and in all cases of partial division by a bullet there is much contusion of the nerve tissue that is not severed. It thus happens that in many cases after the effects of contusion have passed away, the patient is left with a more permanent paralysis due to the complete division of some of the nerve fibres.

In such a condition as this, the same time is required for repair and the restoration of function as if the fibres had been completely divided and successfully united by primary suture, and it is therefore not to be expected that paralysed muscles will be restored to their proper bulk and use for about a year, and perhaps more. It is as well to recognise this fact as clearly as possible, and it appeared to us that many surgeons seemed to expect a much more rapid recovery than can possibly take place when motor fibres have been divided and muscle has atrophied.

One of us had the opportunity of seeing various cases of nerve wounds sustained in the Tirah campaign, and in one of these it was evident that the sciatic nerve had been wounded, though not divided—a condition often met with in South Africa. The patient, who was a young officer, made steady improvement after his return to England three months from the time of the injury, but at the end of a year his wasted muscles had barely recovered their bulk and were liable to tire very soon. In spite, however, of so long a delay recovery was ultimately complete, and we have seen very many patients whose nerves have been wounded in South Africa, and whose cases seem to be running a similarly favourable course.

Scar Pressure on Nerves.—We did not meet with any cases in which nerves had been compressed by scars, unless there had been distinct evidence that the nerve had been injured at the time of the wound. On the other hand, there are a good many cases in which, when there have been symptoms of partial division, the nerve has been found to be also compressed or displaced by the hard string-like scar that often results from the passage of a bullet through a muscle.

Nerve Injuries Complicating Fractures.—It is well known that fractures of the humerus in its middle are liable to be complicated by paralysis of the musculo-spiral nerve, and this was a rather common event in the gunshot fractures of this bone. The nerve was perhaps sometimes injured by the bullet itself, but it is probable that it was far more often damaged by the fragments of broken bone. In other cases, no doubt, as in civilian practice, it was subsequently caught up and compressed by the callus uniting the fracture whether it had been previously injured or not. In such cases the usual and characteristic wrist-drop, with paralysis of the extensors of the wrist, fingers, and thumb, as well as of the supinators of the forearm, made the diagnosis easy.

Treatment of Nerve Injuries.—It can never be good surgery to cut down upon and to attempt to suture a nerve directly after the infliction of a bullet wound apparently involving a nerve trunk. It has already been pointed out that in very many such cases the loss of power and the anæsthesia may be very transient, and in many others where the original symptoms appeared to point to an extensive injury of several nerves, a few days later, apparently paralysed parts recovered. If primary suture became the rule, very many unnecessary and harmful operations would be undertaken.

It is therefore to be assumed that in all cases of nerve injury by bullets, some little time will be allowed to elapse before any operation is advised, and if operation for suture proves to be required, it is well to remember that it will

usually be quite as satisfactorily performed within two or three weeks after injury as within a few days.

The most reliable indications that a mixed nerve is completely divided are the rapid wasting of all the muscles it supplies, and the total loss of all Faradic excitability after the lapse of six days. The complete loss of sensation in the skin area supplied by the injured nerve is, of course, a very valuable indication, but is not so important as is the loss of Faradic excitability and the wasting of muscles. If therefore these latter conditions can be definitely established, it is certainly advisable to expose the nerve involved, and if it be severed, to suture it if possible. This is, unfortunately, by no means always practicable, and where explosive effects have been marked, suture may well be impossible, for several inches of nerve may be destroyed; we have thus seen one case where apparently about five inches of the ulnar nerve had been shot away. In bullet wounds also of the brachial plexus close to the spine or behind the clavicle suture may prove impracticable, and in any wound of the plexus in the neck it is often very difficult to approximate the separated ends on account of the inability to sufficiently relax the injured cord.

In addition, however, to the cases where section of a nerve trunk is evidently complete, there is a very much larger number of cases in which the affected limb is more or less crippled, and is sometimes the seat of a good deal of aching pain, yet where it is evident that the nerve trunk is not completely divided.

Unless pain is severe, there is usually no need to hurriedly interfere in this class of case, but, on the other hand, if improvement is very slow or else absent, it is just as well to operate and see the state of affairs, although this action is usually not advisable unless there is much pain or extensive muscular wasting. Nothing is more difficult than to decide whether in any given patient an operation is necessary, or whether the case will do as well if left

alone, but if the nerve trunk is easy of access by a simple operation, then "when in doubt operate" is a good and safe rule.

In such cases it is to be expected that benefit will result by freeing the nerve from adhesions which displace and drag upon it, and from scar tissue which compresses it, and it is very seldom wise to resect an injured piece of nerve and suture the cut ends. Even if this is successful, union will generally take longer than if the nerve is simply freed and stretched.

The actual conditions found at operations vary somewhat. In some cases where a nerve has been wounded its condition is but little altered, but in other cases it is much displaced, so as to be bent at a sharp angle at the point of injury. In some cases the nerve seems flattened and atrophied, whilst in others it is thickened and enlarged by the growth of a "traumatic neuroma." In one case under the care of Sir Thomas Smith which one of us saw with him, a piece of the mantle of a bullet was found imbedded in the sciatic nerve which had evidently been shot through at this point, and had developed a traumatic neuroma.

Massage and Galvanism.—In almost all nerve cases, after the wound has healed and the pain and sensitiveness have passed by or are lessened, very much may be gained by regular daily massage and the careful use of galvanism. The great majority of nerve wounds require no operative treatment, if, in addition to these measures, the part is carefully kept warm in cold weather, and used a little rather than kept completely at rest. Improvement will often be most satisfactory, though in many cases much patience is needed before a final cure results.

A good prognosis is justified so long as there has been no extensive loss of nerve tissue, and if separated ends have been united. But it must be clearly borne in mind, that the process of restoration of degenerated nerve and muscle is always slow, and that parts which

show little improvement after six months or even a year, may ultimately recover completely.

The following brief notes will indicate how many different nerves were wounded at one time or another, and how common such injuries were.

(1.) Wound of Pneumogastric.—A private was shot through the right orbit at Magersfontein, the bullet traversing the jaw-bone and palate, and emerging through the left side of the neck just at the back of the thyroid cartilage. There was a complete paralysis of the left vocal cord, followed by atrophy of its muscles, which could only have been caused by a wound of the pneumogastric nerve, but the patient had no other symptoms which could be attributed to such an injury, and made a good recovery.

(2.) Wound of Sympathetic in the Neck.—A private was shot through the right side of the neck, the bullet entering at the middle of the left cheek, and passing out one inch and a half to the right of the spinous process of the seventh cervical vertebra. The left eyeball showed the typical retraction of the globe within the orbit, the diminished palpebral fissure, and the paralysis of the dilator muscle of the iris characteristic of paralysis of the sympathetic nerve.

(3.) Wound of Spinal Accessory Nerve.—A man shot through the fleshy part of the left shoulder, two and a half inches above the clavicle, had paralysis of the trapezius as a result of wound of the spinal accessory nerve.

(4.) Wound of a Cord of the Brachial Plexus.—A private of the Shropshire Light Infantry was shot at Paardeberg whilst firing in the prone position, and was rendered unconscious for a few minutes. The entrance wound was a typical Mauser aperture, situated an inch and a half below the left mastoid process. The exit wound was situated at the level of the cricoid cartilage, and about one inch to its right, so that it was placed just over the carotid sheath. The bullet had then again entered an

inch below the clavicle and close to the coracoid process, and finally emerged in the middle of the right posterior axillary fold. Considering the nature of the wound the man was little injured, but there was partial paralysis of the muscles supplied by the median nerve, and anæsthesia of the index and middle fingers. The other vessels and nerves in the neck and axilla had escaped.

(5.) Wound of a Cord of the Brachial Plexus—Transient Paralysis of the Triceps.—A corporal in the Inniskilling Dragoons was shot at short range (100 yards?) at Arundel, the bullet entering the anterior fold of the axilla at the level of the surgical neck of the humerus, and passing almost directly backwards so close to the bone that it looked as if it must have injured the humerus. The man immediately lost all power in the triceps, and for a fortnight this muscle remained almost quite paralysed. After that time it rapidly recovered, so that ten days later it had regained power completely.

(6.) Extensive Injury of the Brachial Plexus.—A private in the Cheshire regiment was shot at close range (50 yards?) at Jacobsdal. The bullet, a Mauser, entered half an inch below and to the outer side of the coracoid process, and passing downwards and backwards, emerged in his back half an inch to the right of the fifth dorsal spinous process. The patient at once lost power in the arm, and had symptoms pointing to extensive injury of the brachial plexus.

Except for some movements of the shoulder muscles the arm hung limp by his side, the patient being unable to flex, supinate, or extend the forearm, though there was a little feeble power of pronation. The hand and forearm muscles were all paralysed, except for retention of power in some of the ulnar group, and sensation was lost over a corresponding area. The further history of this patient we have not yet ascertained.

(7.) Amongst some Boer wounded we saw three men, all of whose wounds were complicated by injury of nerves. In

two of them the bullet had passed across the middle of the upper arm, apparently dividing the ulnar nerve in one man, and wounding, but not completely dividing, the median and ulnar nerves in the other. In the third man the median nerve had been struck but not divided, and this patient suffered from very severe burning pain in the hand.

We saw one day with Civil Surgeon Stewart, in No. 3 Hospital, no less than five men with injuries of nerves of the upper extremity which may be briefly summarised.

A. C., shot by a bullet, fracturing the clavicle, and passing directly backwards through the trapezius, and causing paralysis of his triceps, brachialis anticus, and coraco-brachialis.

J. M'C., shot through the triceps, with resulting paresis of the muscles supplied by the median and ulnar nerves.

D. C., shot right across the axilla, high up, with complete musculo-spiral paralysis as a result.

Sergeant C., wound of entry at the insertion of the right deltoid muscle, with exit in the neck on the same side, in the upper part of the posterior triangle. This patient had apparently lost all motion and sensation in the upper extremity, and the track of the bullet seemed to pass right along the line of the brachial plexus.

A. B., shot through the middle of the upper arm on its outer side, and has complete wrist-drop and paralysis of the extensors of the forearm.

All these patients arrived in one convoy of wounded.

In the lower extremity the nerve most often injured was certainly the sciatic, although it was very rarely completely divided. It was also very curious that when not completely divided, the fibres which go to form the external popliteal division were much more often involved than were those of the inner part of the nerve. This special implication of the outer part of the sciatic nerve affected both sensory and motor fibres, the anæsthesia being most marked in the sole of the foot, which was

also usually the last part to recover. In a considerable proportion of cases of fracture of the femur, the sciatic was injured by either the bullet or the fragments of bone, but it cannot be said that the nerve injury affected in any way the uniting of the fracture. Many patients suffered very little pain, but, on the whole, more men suffered pain from injury to the sciatic than from injury of other nerves, and in some patients the pain was very severe and long lasting. In practically all the patients the pain came on at once, or very early, and if there was no severe pain when the first few days had passed by, it was very unlikely that severe pain would subsequently ensue. Many patients with symptoms of injury of the sciatic improved or got quite well after the lapse of three or four weeks, but in very many more the paralysis lasted a very long time, and some men have not yet recovered from the effects of wounds inflicted a year or more ago.

When exposed by operation, some of the sciatic nerves appeared to have been shot through or perforated, whilst others presented a lateral thickening due to the development of a traumatic neuroma. We do not know of any case in which the sciatic nerve was found to have been divided completely.

In one case we operated on, six months after the infliction of the wound, the track of the bullet led through the sciatic nerve, and the latter was bent very sharply at the seat of injury, and was fixed by firm adhesions to the place where the bullet had gone through the biceps muscle in its passage out of the limb. In this case immediate improvement followed on the release of the nerve from the adhesions.

Wounds of the other nerves of the lower extremity were not of nearly such frequent occurrence as were nerve wounds in the upper extremity, and though we saw cases of injury of the main divisions of the sciatic nerve, they do not call for special comment.

In one case the patient was an officer who was shot

through the neck of the fibula, and had a complete paralysis of the external popliteal nerve. There was much wasting of muscles and some pain, with limping and dropped foot on trying to walk. It turned out, however, that this was one of the cases of contusion and not of division of the nerve, for, with massage and galvanism, he made a complete recovery in between three and four months.

CHAPTER XIV

WOUNDS OF THE THORAX

NON-PENETRATING wounds of the thorax require no special mention, for the injuries of the skin and muscles around it offer no special material for separate consideration.

Penetrating wounds may be classified as :—

(1.) Wounds of the Bronchi and Lungs.
(2.) Wounds of the Heart and large vessels.

(1.) Wounds of the lung were of very frequent occurrence, and of those treated in the Base Hospitals the great majority made good recoveries. It was, however, noticeable that in the majority of these cases the wounds were not so placed as to make it probable that the root of the lung had been traversed, and considering how seldom we saw such injuries in proportion to the other thoracic wounds, it seemed to us very probable that not a few of the patients shot through the root of the lung died shortly after the injury had been inflicted.

The wounds we saw traversed the lung in very different directions, and a considerable number of them being inflicted whilst the men were lying down or stooping, the bullet passed through the lung obliquely from above downwards.

We did not see most of the patients until a day or two after injury, and as in all lung wounds the most urgent symptoms occur early, before the sound lung and the heart

have had time to adapt themselves to the altered conditions of the pulmonary circulation, we saw the patients after they had recovered from the sudden congestion and dyspnœa which so often characterise a serious injury to the lung. It must therefore be remembered that the patients at the Base Hospitals were the survivors of perhaps a considerably larger number of men who had been shot through the chest, for if these wounds are fatal at all, it is soon after their infliction that death results, and such injuries differ in this respect very materially from most injuries of the limbs, which, if they cause death at all, are very likely to do so, at a later date.

The experience of the Base Hospitals, in fact, is especially liable to be misleading, as far as mortality is concerned, when dealing with wounds of the viscera, and this must constantly be borne in mind.

Symptoms.—As a rule the passage of a bullet through the lung caused sufficient shock or difficulty of breathing and pain to prevent a man from continuing to fight, but in a few exceptional cases there were practically no symptoms, and we will mention one of them as an example.

A man whilst firing in the prone position felt his pipe break in his breeches pocket, and presently put his hand down to feel what had happened. He withdrew his broken pipe and also a bullet, and then finding some blood on his hand, thought he must have been wounded. As it turned out, he had been hit by a bullet which entered the shoulder and traversed the lung and abdomen, and yet had caused him no pain or sense of injury.

Hæmoptysis.—In many cases there was hæmoptysis, which in our experience did not last more than three days as a rule, but it was generally surprisingly slight, and had sometimes not been noticed at all. It is, of course, possible that some patients, shot through the root of the lung, died of the hæmorrhage on the battle field, but, considering that the passage of a trocar into the lung is not necessarily followed by blood spitting,

it is quite possible for a bullet also to traverse the pulmonary tissue without causing passage of blood into the bronchi. We saw no case in which the hæmoptysis required any special measures for its arrest.

Hæmothorax.—This was a common complication, although it only occurred in a minority of the cases. It seemed to us to be rare in all wounds of the apex of the lung, but we could not point to any definite class of lung injuries in which it was specially common. Its occurrence and the quantity of blood extravasated bore no direct relation to the severity of the hæmoptysis, and it is very probable that, in some cases at least, the extravasated blood came from a wounded intercostal vessel, though we do not think this would explain more than a small minority of the cases observed.

The accumulation of blood in the pleura was generally signalised by slightly more rapid breathing and heart action, and by a rise of temperature. Under these circumstances an examination of the chest revealed the usual absence of normal respiratory movement and the general symptoms of blood in the pleura characteristic of this condition. In many of these cases, however, the dullness was by no means so definite as might have been expected, for there was often free air in the pleural cavity, and in many such cases the "bell sound" could be readily elicited by striking one coin against another held in contact with the thoracic wall.

The amount of fluid and of air in the chest were seldom sufficient to cause much displacement of the heart or serious difficulty of respiration, and in the few instances where urgent dyspnœa occurred it was more often due to the addition of inflammatory exudation and to the commencement of pleurisy or empyema, the onset of which might be delayed for some weeks after the wound had been received.

The following is a case in point:—

An officer, aged 60, commanding a troop of Colonial

Horse, was shot through the right side of the chest at the level of the third rib. He suffered from some shock and dyspnœa at the time, but when one of us first saw him a day later, he was better and had but few symptoms except pain on respiration and on coughing. There had been very little hæmoptysis, and there was no hæmothorax or empyema. Within a week he was able to sit up in a chair, but did not go on improving, and gradually suffered more from difficulty of respiration, but without pyrexia or pain. At the end of four weeks he had developed a pleural effusion, and when this was tapped and several pints of clear fluid evacuated, he was at once relieved.

It has already been mentioned that a hæmothorax is often ushered in by pyrexia, and it must be clearly borne in mind that these cases normally run a definitely pyrexial course of a week to a fortnight and sometimes more, the temperature reaching about 101° or 102° on the second or third days, and remaining above 100° in the evening for several days more. In the early days of the war we found that this pyrexia had caused resort to aspiration, puncture, or incision in some cases, under the impression that septic infection had occurred, and it is therefore the more necessary to insist that such fever is the usual accompaniment of a hæmothorax, and is presumably due to the pyrexial properties of the fibrin ferment in the extravasated blood.

The two following cases illustrate the conditions commonly met with in wounds of the lung:—

A trooper in the 10th Hussars was shot on 16th February near Klip Drift, whilst lying down firing at a range of about 1200 yards. He spat no blood, but had great pain and felt too ill to walk. A field dressing was applied in about half an hour, and he was carried to a neighbouring house. Two days later a journey of five hours in a bullock cart landed him at Jacobsdal, and again in two days a similar journey brought him to Modder River Camp, when he was put in a train and taken to Rondebosch.

He arrived at the Portland Hospital on 23rd February, when his breathing was short and painful, and his pulse 100. As he was much exhausted, and very much upset mentally, he was kept perfectly quiet for two days, and then was examined.

The wounds were dry and scabbed. That of entry was situated in the third left interspace directly above the nipple, and the aperture of exit was in the sixth interspace on the same side, just outside the angle of the scapula. The heart was not displaced, but the evidence of hæmothorax was found in the absence of vocal fremitus and breathing sounds except at the apex, and the fixity of the left side of the chest. The evening temperature was 101°.5, and for the next ten days it remained above 100°, while the respirations were generally about 30 in the minute, and the pulse kept between 90 and 100. At the end of a fortnight the temperature was normal, and five weeks from the date of his admission he was discharged in good health and with no abnormal physical sign in his chest.

P. C., a private in the Gordon Highlanders, was shot on 30th April at a range of about twenty or thirty yards, whilst riding up to a kopje supposed to be unoccupied. He was unconscious for seven or eight hours, and then crawled to a kaffir kraal a few hundred yards away, but did not get back to camp till the third day after being wounded.

On 5th May he was brought to the Portland Hospital after two days in an ox-waggon, having been spitting up blood occasionally ever since he came to his senses.

The entrance wound was in the back on the left side, two inches from the spine in the ninth interspace, and the aperture of exit was in the fourth interspace on the same side in the anterior axillary line.

There was a little surgical emphysema at the base of the axilla. The left side of the chest was dull except at the apex, breathing sounds were feeble, and there was no vocal fremitus. The apex beat of the heart was displaced inwards an inch or more, but there was no evidence of air

in the pleural cavity. There was a nightly rise of temperature to 100° or more, and in the morning also it was usually above normal.

In this patient there was evidently a large hæmothorax, and the course the case ran confirmed this opinion, for, at the end of a fortnight in bed, the physical signs had not changed much, and two or three more weeks passed before the patient was sufficiently convalescent to be sent down to the base at the Cape.

Surgical emphysema was very rarely met with, and we did not see a single case in which the air extended beyond the tissues immediately around the wound apertures. It is also not to be supposed that this immunity from emphysema was due to the escape of the air through the wound in the skin, for in almost every case this was already closed by clot or dressing.

Pleuritic effusion apart from hæmothorax was rare, as was also empyema, and when they did occur, they presented the usual clinical conditions met with in these complications at all times.

The ultimate results of most cases of bullet wounds of the lung are very satisfactory, and where there has been no hæmothorax to delay convalescence, most patients are able to be up and about again within a week or two, and many men so injured were able to go back to the front, none the worse in any way for their experience. When there has been a large hæmothorax, however, there is a much more prolonged convalescence, and it would seldom be wise to allow a man to return to an active occupation for several months, although ultimately the lung is likely to recover completely.

Treatment of Bullet Wounds of Lung.

In these, as in almost all other bullet wounds, the antiseptic occlusion of the apertures of entrance and exit is the first essential. If the bullet has lodged under the skin, it should certainly not be removed at

once, for, in the first place, it can do no harm in this situation, and, in the second place, the removal may open up the pleura to infection from without, considering that it is impossible soon after an action to ensure the continuance of proper dressings in a patient who may have to be sent a long journey to the base at very short notice. In one case, at least, a very serious empyema resulted from the removal of a bullet in such a case, and it is evident that the waiting for a very few days will ensure the shutting off of the bullet from the pleura, and then, if necessary, it can be extracted without risk.

The general management of these cases does not differ from that which is necessary in the injuries of the lung met with in civil practice complicating fractures of the ribs. Complete rest is almost all that is required, and is perhaps even more essential than in most gunshot wounds, although, unfortunately, the necessity of transferring the wounded to hospitals has very often resulted in the patient not getting real rest and quiet for several days. Where such moving can be avoided, it is most desirable that the wounded man should not be sent long journeys. It is only in cases of severe hæmoptysis that it is necessary to give such drugs as turpentine, ergot, hamamelis, or gallic acid to arrest the bleeding. In some cases, indeed, the loss of blood distinctly relieves the urgent dyspnœa due to the partial collapse of one lung and the consequent engorgement of its fellow, so that no harm need be anticipated from a moderate hæmoptysis.

In cases complicated by hæmothorax it is quite certain that, as a rule, the blood may safely be left in the pleural cavity, and that it will be absorbed without complication in the great majority of cases. It is only when, after several days, dyspnœa continues and the hurried respiration does not quiet down that the withdrawal of the effusion may be considered. For even when there is a well-marked hæmothorax soon after a lung injury, it must

be remembered that any dyspnœa that may be present may well be independent of the pressure of blood in the pleura, and due rather to the congestion of the opposite lung and embarrassment of the heart; and further, it must be clearly borne in mind that the early withdrawal of blood extravasated in the pleura may start afresh a hæmorrhage that has ceased.

If, therefore, after a delay long enough to allow of a closure of the lung wound and the passing away of the pulmonary congestion, dyspnœa continues, with evidence of much fluid in the chest, it may be wise to draw off some of the blood through a cannula with every possible antiseptic precaution, and it must be also borne in mind that the use of an aspirator requires great caution, for if much suction be employed bleeding may be again induced thereby. It is indeed quite sufficient to draw off only as much fluid as will readily flow out, and there is no need to attempt to empty the pleura, for the only good that can come of tapping a hæmothorax is to be obtained by relieving the lung from the pressure which interferes with its expansion, and this is attained when the normal elasticity of the lung and the act of respiration has allowed it to expand and expel the fluid through the opening provided by the cannula. If the lung cannot completely expand because it has not yet recovered sufficiently, it is evident that the pleura must be left with either fluid or air inside it, and that no good can be obtained by trying to suck out that which does not readily avail itself of the exit provided by the puncture.

With these precautions in mind, then the evacuation of some of the fluid may be very useful, and it further seems, in many cases, to promote a more rapid absorption of that which remains. It is, however, not desirable to puncture again until after an interval of several days, and in many cases a single removal of a portion of the pleural effusion is all that is required.

In those cases where the effusion becomes purulent, the

symptoms usually indicating retained pus become evident, and are generally associated with the physical signs of increasing effusion in the pleura. If, therefore, in a case of hæmothorax there is an increase of the fever, with sweating, increased rapidity of pulse and respiration, and dyspnœa, an exploratory puncture should be made, and if pus is found, the sooner a free incision and drainage gives exit to it the better for the patient's chance of recovery, though it must be confessed that these cases of acute empyema are very serious, and we saw at least one fatal case in one of the military hospitals at Bloemfontein, as well as others which were not progressing very favourably.

Wounds of the Heart.—We have had no practical experience of wounds of the heart, but it cannot be doubted that such injuries are usually fatal. Sir William MacCormac has pointed out in his interesting paper, read at a meeting of the Royal Medical and Chirurgical Society last year, that in some cases it was difficult to resist the conclusion that the bullet must have wounded some part of the heart without causing death, but, although we also have seen such cases, we are not aware of any such case in which there has been any definite symptoms such as hæmorrhage into the pericardium, indicating a heart wound, or where a bullet wound of the heart has been demonstrated at a post-mortem examination when death has resulted from other causes.

CHAPTER XV

WOUNDS OF THE ABDOMEN

THE great advances made during recent years in the surgery of the abdomen, and the increasing safety of operations on the intestine itself, seemed to promise that bullet wounds of the abdomen might well be successfully treated by laparotomy, and that intestinal suture would save many lives. It is all the more disappointing to have to record that operations on the abdomen have saved but few men, and that, with rare exceptions, intestinal suture has been unsuccessful. It is, therefore, of much interest to consider anew the results of bullet wounds opening the abdominal cavity, which are uncomplicated by injuries of the solid viscera.

The question that naturally arises first is whether it is possible for a bullet to traverse the area occupied by the small intestine without necessarily opening a coil of bowel. To this the answer must certainly be in the affirmative, and we will content ourselves for the present by alluding to a case, the details of which were supplied us by Mr Lenthal Cheatle.

A private was shot right across the abdomen in a fight to the west of Pretoria, and died forty-eight hours later. The bullet had entered low down in his right lumbar region, and had emerged near the left anterior superior spine of the ilium, where it finally lodged, after passing through the skin for half its length; it was a "Jeffreys sporting bullet." The post-mortem examination showed

that the projectile had passed through the cæcum transversely, close to its posterior wall, and had passed out through the sigmoid flexure, in which it made a large rent. It was thus clear that the bullet had passed right across the cavity of the abdomen, and, having entered it posteriorly and passed from behind forwards, it had thus traversed the abdomen in its antero-posterior diameter as well. In spite of this, however, the coils of small intestines showed no wound or abrasion, although there was a most careful search after removing the bowels from the body. Other cases might be quoted, but this one is enough to establish beyond doubt the possibility of a bullet traversing the abdominal cavity below the umbilicus without wounding the small intestine.

The next matter for consideration is whether men have been proved to have recovered from perforating wounds of the bowels. As far as we are aware, the actual proof afforded by the demonstration of wounded small intestine which has healed is wanting. We, at least, do not know of any such case. But it is practically certain that such wounds have healed, and that patients have recovered, so that it may be assumed that such recovery is undoubtedly a possibility. The question that naturally follows is certainly a most difficult one to answer, for the natural inquiry is, "What proportion of patients with wounded intestine recover?" and the answer to this is given very differently by many experienced and thoughtful surgeons, although most of them favour the view that the proportion of recoveries is large. When, however, one comes to examine more closely their reasons for concluding that recovery from wounded intestine is common, one is much struck by the fact that it has been taken for granted in many cases that when a bullet has traversed the peritoneal cavity the intestine must necessarily have been wounded, and this is certainly a most misleading axiom on which to found an argument. Not only has the intestine been found unwounded in patients whose abdominal cavities have been

perforated, but the complete absence of all serious symptoms and of subsequent complications in men who have had no treatment or care in feeding renders it practically certain that in a considerable number of men whose peritoneal cavities have been perforated no intestine has been wounded, so that it is quite erroneous to place such cases in a list of those who have recovered from perforating wounds of the bowel.

We are, in fact, in face of a problem that admits of no definite answer at present, for, in the case of any penetrating wound of the abdomen, with injury of the intestine, it is likely enough that if the man is to recover at all he will very likely do so without any definite diagnostic symptoms arising, if placed under appropriate treatment, and in that case it would never be known whether or not the bowel had been opened. Whereas, on the other hand, if symptoms of peritonitis do arise the great majority of the men die, and, if these alone were counted as cases of perforating wounds of the bowel, there would be but few recoveries to record, and the conclusions would be again misleading. We must, therefore, be content to say that in many cases of perforating abdominal wounds it is not possible to assert or deny that the bowel is opened by the bullet, so that in dealing practically with such injuries we must speak merely of penetrating abdominal wounds of certain areas, and consider their treatment as such.

When the intestine is wounded by a mantled small-bore bullet the wound in it may involve one or many coils of bowel, and in the latter case the wounds in the different coils may all be clean perforations, or some of them may be of the nature of oblique rents. It is probable that the wound in the gut differs somewhat according as the latter is or is not distended, and that if the bowel is collapsed the aperture may very possibly be closed at once by the everted mucous membrane. It is also probable that the thicker and more muscular coat of the large bowel will more easily contract and close an opening than will the

thinner coats of the small intestine. In the case before alluded to, Mr Cheatle found the openings in the cæcum so minute that it was difficult to believe that a bullet had traversed them, and it is most interesting to know that there was no sign of surrounding peritonitis or extravasation here when the patient died 48 hours after the injury. The fatal ending was the result of a very extensive laceration of the sigmoid flexure, although the bullet had not expanded materially, and had not burst its mantle. The accompanying drawing illustrates remarkably well the minute size of the cæcal wounds, and for this illustration, as well as for the opportunity of examining the specimens, we are much indebted to Mr Cheatle.

Both Sir William MacCormac and Mr Treves, in their papers published in Vol. LXXXIII. of the *Transactions of the Royal Medical and Chirurgical Society*, supply evidence to show that the bowel may be wounded without any necessary extravasation of its contents, and other writers have expressed opinions in the same direction, although none of them have been able to indicate in what proportion of such injuries the patients recover.

When inquiries are made of surgeons who have been either in the firing line or with bearer companies or at dressing stations, and when one hears what they have to say of the results of wounds of the abdomen, it at once becomes evident that there is a very great divergence of opinion when their experience comes to be compared with that of surgeons in Field or Base Hospitals; and Mr Watson Cheyne, in the *British Medical Journal* for 12th May 1900, remarks that, although he had gathered at the Base Hospitals at the Cape that "only about 20 per cent. of the abdominal cases had died," his experience after Paardeberg and the fighting at Karee Siding causes him to conclude "that the results were not nearly so good as he had been led to expect."

Our own view is that far too favourable an opinion has been formed of the results of such injuries, and we

CÆCUM, showing Entrance Wound of a Mauser Bullet. [*To face page* 268.

CÆCUM, showing Exit Wound of a Mauser Bullet. [*To face page* 268.

have come to this conclusion after a good deal of inquiry.

Mr Watson Cheyne, in the paper just alluded to, says: At Karee "the number of wounded was 154, and in 15 it was considered that the abdominal cavity had been penetrated. Of these patients 5 had already died within twenty-four to twenty-eight hours after the injury, and I saw 10 who were still alive. Of these, 9 were left alone, and 4 died within the next twenty-four or thirty-six hours; 5 were alive when I left Karee on 1st April (*i.e.*, on the third day after the fighting). On one I operated, but he died on 2nd April. So that in three days 10 out of 15 were dead, and it is not certain that any of the other 5 completely recovered, though it is probable that some at least did so. The same surgeon says: "At Paardeberg and Driefontein I saw 12 cases. Of these, 11 were left alone, with 7 deaths, and 4 recovered to a sufficient extent to enable them to be sent to the base. The one operated upon died. . . . I may add that among my cases which are improving there are several in which the probabilities are that no abdominal viscus was injured."

Thus, of 27 cases of abdominal wound 2 men operated upon died, and of the remaining 25, 16 died and 9 recovered. Some of these may have subsequently died, and those who recovered may or may not have had injuries of the intestine. Four of these nine were shot quite in the upper part of the abdomen, and above the level of the small intestine.

Mr Cheatle sums up his experience briefly, and says, but "I have never seen recovery from an obliquely or transversely directed (penetrating) wound. I have seen recovery in one case of a horizontal and antero-posterior wound."

The following are brief notes of ten cases seen by Mr Cheatle:—

1. HONING SPRUIT.—Mauser; range 1000 yards. *Entrance*, just above the highest point of the crest of the ilium on right side; exit, below level of ribs on the left

side, in the mid axillary line. Died about 36 hours afterwards.

2. A Kaffir.—Mauser, at 10 yards range (I saw him shot on a trolly). *Entrance*, 1 inch behind and above the highest point of the crest of the ilium; exit, corresponding point on opposite side. Died 21 hours afterwards. There was profuse hæmorrhage both externally and into the peritoneal cavity.

3. PRETORIA.—Mauser. *Entrance*, 1½ inches above and to the left of the umbilicus; exit, corresponding part posteriorly. Perfect and uninterrupted recovery.

4. DEWETSDORP.—Mauser wound; range 500 yards. *Entrance*, 2 inches above and to the left of the umbilicus; exit, 1½ inches above the crest of the ilium and 2½ to 3 inches behind the mid axillary line. Died about 48 hours afterwards.

5. MODDER RIVER.— Mauser, 800 yards range. *Entrance*, 1½ inch above great trochanter; exit, corresponding part on right side. Lived 20 days after wound inflicted. I had him when he was moribund, and he was then suffering from a huge subcutaneous collection of pus (which I freely opened), extending over his back and down his left thigh, contents of which were gas, pus, and fæces. The rectum evidently had been opened (probably did not open the peritoneum).

6. VET RIVER.—Mauser wound; range 500 yards. *Entrance*, just outside the border of the right erector spinal muscle of the right side, at the level of the fourth lumbar vertebra; exit, bullet subcutaneous below the border of the ribs, on the right side. Died 36 hours afterwards.

7. JOHANNESBURG. Mauser wound; range about 400 yards. *Entrance*, just above the highest point of the crest of the ilium, on the right side; exit, bullet lodged in exit wound, base foremost, at a point corresponding to the level of the wound of entrance. No hæmorrhage to speak of; small wounds in cæcum, and large wounds in sigmoid flexure; no injury to small intestine. There were results

of infection and fæcal extravasation around the sigmoid flexure — general peritonitis. Died 48 hours after the injury.

8. VENTERSBURG ROAD.—Boer. Lee-Enfield bullet; range 50 yards. *Entrance*, just above and behind the right anterior superior iliac spine; exit, mid axillary line, on the left side, midway between the last rib and the crest of the ilium. Lived 24 hours. Moribund when I saw him.

9. Mauser wound; range 50 yards. *Entrance*, middle line, immediately above the symphysis pubis; exit at the right sacro-iliac synchondrosis. Died in 36 hours. The bladder was wounded, and there was general peritonitis. Moribund when I saw him.

10. Mauser wound; range 50 yards. *Entrance*, in the mid axillary line, at the level of the umbilicus, on the left side; exit on right side of the tip of the ensiform cartilage. Dead in ambulance when I saw him, and he had died 11 to 15 hours after the injury.

"The only recovery was in one direct antero-posterior wound, above the level of the umbilicus. All the rest died, and had oblique or transverse wounds. I do not think that cases which die after about 48 hours can all die from bleeding, for the one post-mortem examination I was able to make showed no marked hæmorrhage. I should say this man certainly died from injective peritonitis, due to fæcal extravasation."

Mr Gordon Watson tells us that in the fighting with De Wet near Bothaville, two men were shot through the abdomen without evident injury to the solid viscera, and both of them died with symptoms of collapse and hæmorrhage within a few hours. One man shot through the lumbar region made a good recovery, but the wound was situated so as to miss the small intestine.

It would appear from a paper in the *British Medical Journal* for 2nd June 1900, that of the men treated in No. 18 Field Hospital, and who were wounded in the abdomen

at the battle of Talana Hill, none recovered. The exact number is not stated, but appears to have been only two or three.

Sir W. MacCormac, in the paper read before the Royal Medical and Chirurgical Society, and already alluded to, says: "In the report of the Surgeon-General of the United States of America, it is recorded that of 44 penetrating abdominal wounds 30 died, and that operative interference was only resorted to in 4 of them." This refers to the fighting in Cuba.

In the February number of *The Annals of Surgery* for the current year, Dr Robinson, in the course of an interesting paper on the surgical experiences of the war in the Philippines, says: "In our records there are 45 cases of penetrating gunshot wounds of the abdomen. Eight of these were brought in dead, or died in twenty-four hours, before any operative interference was possible. Of the 37 remaining, 34 were from the Mauser or Krag (bullet). Of those, 30 were treated without operation, 20 recovered, and 10 died—a percentage of $66\frac{2}{3}$ per cent. recovery. . . . The liver, kidneys, and bladder were repeatedly punctured, and the cases recovered as if from a simple wound, with the least possible inconvenience. Death from hæmorrhage usually followed wounds of the spleen. Our record contains but one bullet wound of this organ that recovered. Of the 4 cases (of abdominal wounds) operated upon, 3 died and 1 recovered. This latter case demonstrates conclusively the point mentioned so frequently by Col. Nicholas Senn, that a Mauser or Krag bullet may pass directly through the abdomen above the umbilicus without causing great damage. . . . Three gunshot wounds of the abdomen were from Remington bullets. One of these recovered without an operation, but developed a double fæcal fistula. One died, and one was operated on, but succumbed to shock in twelve hours."

It will thus be seen that of the total of 47 cases, 21 men wounded by small-bore bullets died, and 2 men

wounded by Remington bullets died, so that altogether 23 succumbed to their wounds—a total of nearly 50 per cent. Considering, also, that some at least of these wounds did not involve the area occupied by the intestine, and that special stress is laid upon the fact that men shot through the liver and kidneys recovered, it becomes probable that a still larger proportion of men wounded in the intestine died from their injuries than would appear from the total numbers taken alone.

We have, in fact, been gradually driven to the conclusion that the great majority of men shot through the small intestine die, and we think that the very generally expressed opinion that such wounds are comparatively seldom fatal is very little supported by fact. It is also contrary to our own experience of bullet wounds in civilian practice, for these are very fatal injuries, though it must be noted that they are very seldom caused by mantled bullets.

From what we have been able to learn, we are of the opinion that a considerable number of men shot through the abdomen die very quickly, or within a few hours, and we think that the patients who were to be seen at the Base Hospitals were to be regarded as men who had either escaped injury of the bowels and bleeding into the peritoneum, or in whom perforation of the intestine had not been followed by its usual complications. They represented the few survivors of a large number of men who had died from wounds of the abdomen implicating the small intestine, and were not to be regarded as in any way illustrative of the usual results of such injuries.

Wounds of the Mesentery, the Omentum, and the adjacent Blood-Vessels. Intra-Peritoneal Hæmorrhage.

It is very evident that the mesentery is at least as likely to be wounded as is the intestine; and it would seem that it seldom escapes when the intestine suffers. It

may also be wounded when the bowel escapes, and so also may the omentum. Such wounds are always likely to cause some hæmorrhage ; and it is a fact well recognised in civilian practice, that a very small tear of the omentum or mesentery may easily be followed by the gradual escape of a considerable quantity of blood. Disasters following abdominal operations have caused surgeons to be very careful that no small vessels escape being ligatured. It is therefore not a matter for any surprise that even wounds so situated as to avoid the solid viscera and the large blood-vessels were often followed by symptoms of loss of blood, and by death. It is probable that many of the men who died quickly with such symptoms of hæmorrhage died of bleeding from the mesenteric vessels.

It must, however, be remembered that there are a great many vessels in the abdomen and pelvis of the largest calibre, and surgeons are a little prone rather to give undue prominence to the question of wound of the bowel, and to forget that, independently of injury to the intestine or its mesentery, a man may die from a wound of some of the numerous branches of the internal iliac vessels or from wounds of the splenic, hepatic, renal, or gastric arteries and veins. There is too great a tendency to jump to the conclusion that if a man is becoming collapsed after an abdominal wound he is suffering from an injury to the intestine, for it is certain that some at least of these patients are suffering merely from bleeding into the peritoneal cavity without injury to any viscus.

A good case of the kind is recorded by Dr Robinson in the paper already alluded to, and will repay consideration. He says: "In case No. 8750, a private in the 37th Infantry was struck by a ricochetted Krag (bullet) whilst at target practice. The ball entered two inches above the border of the ribs in the left mammary line, and, taking a downward and backward course, lodged in the left loin. As the man was received in the hospital within an hour after the injury, contrary to the usual course operation was

decided on. The abdomen was opened in the middle line, and a large amount of free blood and clots removed. It was found that the ball had passed through the omentum and mesentery, but that the intestines had entirely escaped injury. The bleeding arteries were tied. . . . . Primary union resulted.

Here, then, was a case in which had the abdomen not been opened promptly the man would probably have died of hæmorrhage ; and it is very probable that, considering the passage of the bullet through the peritoneum, he would have been put down as dying from an injury of the bowel.

In other cases, again, the patient has died with all the symptoms of recurrent hæmorrhage, and Mr Watson Cheyne, in the paper alluded to, describes the case of a man who had survived for six days after a wound by a bullet which " entered behind in the right lumbar region and came out in front close to the umbilicus," and who had suffered for two days from severe peritoneal symptoms, vomiting, etc. It seemed, however, that he would recover, but when straining at the bedpan he suddenly became collapsed, complained of severe pain in the abdomen, and died in twenty minutes.

Mr Makins also graphically describes how a man, who had been progressing favourably towards recovery after a perforating abdominal wound, suddenly stood up and exclaimed : " Why, I am going to die, after all ! " and then quickly becoming collapsed, died in a few minutes with the belly becoming suddenly distended. This was also evidently a death from copious intraperitoneal bleeding.

Wounds of the Liver.

Uncomplicated wounds of the liver due to small-bore bullets have done well, and it seems probable that the great majority of the patients have recovered. We frequently saw one officer who had been shot at very long range by a Mauser bullet that entered the sixth left interspace, just behind the posterior axillary line, and passing downward and

to the right, emerged at the right costal margin through the cartilage of the fifth rib, thus traversing the whole liver. The bullet must have passed very near to the heart, and there was much cardiac disturbance and irregularity of action ; but the liver wound gave rise to no symptoms whatever, and the patient recovered, only to succumb a couple of months later to a prolonged attack of enteric fever, followed by dysentery.

Some liver wounds of which we have heard caused peritoneal hæmorrhage, but we saw none such ourselves, and think that it was not a common complication.

Wounds of the Spleen.

We did not see any of these, but from what we heard they seemed to be of rare occurrence, and to result in very copious hæmorrhage. Dr Robinson's experience in the Philippines was similar, for he says : " Death from hæmorrhage usually followed wounds of the spleen. Our record contains but one bullet wound of this organ that recovered."

Treatment of Perforating Wounds of the Abdomen.

All observers are agreed that the performance of laparotomy as a routine treatment for perforating wounds of the abdomen in warfare is a practice to be condemned. It is manifestly impossible to perform such operations after a battle in which many men have been wounded, and when surgeons may be hard pressed for many hours in dressing wounds, arresting hæmorrhage, and splinting or amputating shattered limbs. The time and the assistance required for the successful search in an abdomen for injured vessels or viscera, and for their appropriate treatment, cannot possibly be spared under such conditions.

And, apart from the press of work, the conditions which could alone justify the resort to laparotomy are often wanting, and in South Africa the difficulty of obtaining clean

water, the dust and the flies, so graphically described by Mr Treves, all tended to produce a state of affairs that peremptorily negatived operations in the cases under consideration.

It must also be remembered that very many times there was no opportunity of attending to wounded men for many hours after they were shot. At Magersfontein and at Spion Kop, not to mention other engagements, many of the wounded had to be left lying out the whole day before they could be put into an ambulance. Again, where men were hit during the wide ranging movements of mounted infantry and cavalry, which extended over many miles of country, as in the advance to Pretoria, it might well happen that a man might be wounded in rough country at a great distance from any Field Hospital, and that he had to be left behind in some farmhouse whilst the regiment moved on. Under such circumstances there was no opportunity for the performance of elaborate operations, even if they had been considered advisable.

It is, however, evident that in all warfare it will happen from time to time that men are wounded near to good hospital accommodation, and under circumstances that permit immediate surgical attention, so that it is not sufficient merely to indicate that operations are not to be undertaken as a rule when men are shot through the abdomen; it is also necessary to consider whether, under favourable circumstances, more can be done by operation to save life, and we propose to deal briefly with this aspect of the subject.

The position of the wound certainly influences the prognosis, and the following statements seem to be justified by the experience of many surgeons:—

1. Antero-posterior wounds are less dangerous than are oblique and transverse wounds.
2. Wounds above the level of the umbilicus are less dangerous than those below that level.

3. Wounds in the lumbar region are less dangerous than those nearer the centre of the abdomen.
4. Wounds in the splenic area are usually dangerous from loss of blood, and wounds of the liver are not nearly so likely to cause such severe bleeding.
5. When a bullet is retained and its direction is unknown, prognosis is valueless.

In all abdominal wounds it is of the greatest importance to move the patient as little as possible after he has been shot. If he can be treated near to where he has fallen, so much the better in every way. One of our own friends, an officer in the R.A.M.C., and who was much impressed with the importance of this rule, insisted on being left close to where he fell when shot through the abdomen, and, perhaps as a result, made an excellent recovery.

In the next place, it is evidently advisable to withhold all food, and to allay thirst when it becomes uncontrollable by giving water in teaspoonful doses, or by administering warm water enemata.

The routine administration of opium or morphia is often advisable, both to allay pain and to limit the intestinal movements. No other drug is likely to be of use.

Death from bullet wounds of the abdomen is generally due either to bleeding into the peritoneal cavity, in which case it is very likely to occur within a few hours of the injury, or to peritonitis following perforation of the intestine, in which case it is likely to be delayed for a day or two, or more.

All surgeons are familiar enough with the symptoms of intraperitoneal hæmorrhage from the rupture of a viscus such as the liver or spleen, and every one attached to a large hospital must have often seen patients suffering from these injuries as a result of being run over or crushed. In many such cases the collapse is so extreme, and death is

so plainly inevitable, that no thought of operation can be entertained; and there are similarly many men shot through the abdomen who are evidently going to die whatever is done for them. It must be realised that in a great many cases the wound is mortal, and that operation can only hasten the end.

At the same time it must be remembered that as in civil practice so in the case of bullet wounds, a timely operation may save life, and it is well to consider what may be done if the conditions are all favourable for the satisfactory performance of an operation and the subsequent care of the patient.

There are two main objects in view in performing laparotomy for bullet wounds: first, the arrest of hæmorrhage; second, the closure of wounded intestine.

We propose to deal briefly with the first of these.

It can never be right to operate merely on the chance of there being intraperitoneal hæmorrhage, but if the patient be seen sufficiently early, the increasing weakness and change of colour, the pallor of the lips, the quickening and weakening pulse, the shallow and occasionally sighing respiration, will all suggest that bleeding is going on. In many cases, also, there may be found on palpation or percussion a swelling, due to the extravasated blood, and in some cases a collection of blood will form a definite swelling in the pouch of Douglas, which is perceptible per rectum.

In not a few cases bleeding into the abdomen causes severe vomiting.

With these symptoms in a patient not yet too ill to undergo an operation, and with favourable surroundings, few surgeons would hesitate to open the abdomen and explore its contents. If the wound involve the splenic region it may be advisable either to remove this organ or to plug with gauze the bleeding area, whilst if bleeding mesenteric or omental vessels are discovered they should of course be tied.

When there has been much loss of blood it may be

wise to leave inside the abdomen a pint or two of salt solution, or else to administer it per rectum, or inject it into the cellular tissues of the axilla, or else into a vein.

Such an operation should, in our judgment, be performed in any case where, with favourable surroundings and the patient in good enough condition, there are clear indications that bleeding is going on, for experience has shown that otherwise most of these patients die.

It must, however, be borne in mind that operation is at the best only likely to save a few lives, for although the hæmorrhage may be the most pressing danger, it may well be that on opening the abdomen the intestine may be found so extensively damaged that a very prolonged operation for its repair is required, and proves more than the patient can survive.

It is for this reason that operations should be more especially undertaken for the arrest of bleeding in these cases where the nature of the wound allows of a reasonably favourable prognosis, and that therefore oblique and transverse wounds below the umbilicus are seldom worth operating upon on account of the number of coils of intestine likely to be injured. Antero-posterior wounds near to the lumbar regions are most likely to prove less complicated, and, the source of the hæmorrhage being more readily found without an extensive search, the operation becomes less prolonged and the chances of recovery proportionately increased.

Nothing could better illustrate the difficulties that may surround the operator than the description of an abdominal section by Mr Treves in the *British Medical Journal* for 10th March 1900. He says:—

"A man was knocked down by a Mauser in the engagement of Monday, 5th February. I witnessed the engagement, and saw the rifle fire and shell fire to which the men were exposed. He was hit at long range, and fell about 1 P.M. He was brought into hospital on a stretcher, having been carried by hand all the way. He came in at

5.30 P.M., having had to wait until the infantry and field artillery had retired. I saw him at once. He was blanched and somewhat collapsed. His pulse was small. He answered all questions promptly. He had had an injection of morphine when picked up, and had vomited twice. There was still much pain, but the abdomen was quite flat. There was evidence of considerable peritoneal hæmorrhage. The wound was a Mauser wound, and was over the left tenth rib in the mid axillary line. There was no point of exit, but a well-marked ecchymosis of the right parietes at the tip of the right twelfth rib suggested the position of the bullet. The case seemed favourable for operation, and I carried out a laparotomy by median incision at once. The following condition was found :—Fracture of tenth rib, lacerated hole in the spleen, enormous quantity of blood in the peritoneal cavity and evidently from the spleen, a linear rent in the upper jejunum 1½ inches long, four holes (entry and exit) in the jejunum at its very commencement, a hole in the lower part of the right lobe of the liver. All the five wounds in the bowel were carefully sutured, the smaller holes requiring, in addition to a continuous suture of the mucous membrane, from three to six Lembert sutures. I found the bullet lying loose under the liver. The wounds in the solid organs had ceased to bleed, and were not touched. The whole peritoneal cavity was flushed out with hot water, which had been passed through a Berkefeld filter after having been boiled. The operation of necessity occupied a considerable time. The patient died shortly after he was removed to his tent."

Here, then, was a case of hæmorrhage into the peritoneum complicated by wounds of the liver and spleen, and by several wounds of the small intestine. The surgeon must be prepared to meet with such conditions, and may well be disappointed thereby ; yet they should not deter him from operating on similar cases again, for it is only by opening the abdomen that the uncomplicated

cases can be diagnosed and dealt with. The patient operated upon by Mr Treves would quite certainly have died if he had been left alone, and so also would the patient whose case is detailed by Dr Robinson on page 274, but who was saved by the laparotomy. When men are evidently losing ground with symptoms of internal hæmorrhage, the few who recover after operation may justly be claimed as men whose lives have been saved thereby.

Operations for Wounds of the Intestine.

It has already been said that it is generally impossible to know by any examination of the wounds whether the intestine has been injured or not. The matter, therefore, presents itself practically thus: What is the proper treatment for a penetrating wound of the abdomen uncomplicated by symptoms of hæmorrhage?

The answer to this would no doubt be given very differently by different surgeons, but the general opinion would be that, on the whole, it is wiser not to operate. We think ourselves that this should certainly be the general rule; but we admit that when the abdomen is perforated below the umbilicus, and within two or three inches of the middle line, there is a good deal to be said in favour of operating at once, considering that, as we believe, very few men with such wounds survive, although, on the other hand, there are no large numbers of recoveries after operation to place on the other side of the scale. The following, however, is a brief account of such an operation being performed within a few hours of the receipt of the wound, and in the absence of any definite indication of injury of the intestine (see *British Medical Journal*, 10th March 1900).

"The man was wounded near Frere at about 4 A.M. on 27th November 1899. He arrived at the Convent Hospital, Estcourt, a distance of about twelve miles, about 10 A.M. It was found that he had been wounded in the abdomen. The posterior wound was about three inches above the right trochanter, the anterior wound to the right of the

middle line, half-way between the umbilicus and pubes. Laparotomy was at once done by Dr J. E. Neale, Civil Surgeon. The abdomen was full of blood; the small intestine was found to be cut right across, and there were four bullet wounds on each side of the cut edges. A piece of intestine fifteen inches long was resected, an end-to-end anastomosis done by Czerny-Lembert sutures. A gauze drain was inserted, and double cyanide dressings used. Transfusion was done with ½ per cent. saline. The patient was fed by rectal injections for forty-eight hours. The drain was then removed. He never had a bad sign. He was kept on slop diet for a month, and enemata were used to keep the bowels regular. The bullet had penetrated the iliac bone, and must have injured some branches of the lumbar nerve, as the right leg suffered slightly. The patient was up and about, gaining strength daily, before he left Estcourt, but great care was taken with his diet."

It is evidently most improbable that the man whose case is here recorded could have recovered without operation, and such a success, on the one hand, encourages surgeons to intervene, and, on the other hand, if taken by itself, would lead to many unnecessary operations.

We will therefore quote a case to show that patients may make a good recovery without operation, when similarly wounded.

"A young officer, aged 22, was shot by a Mauser at a range of about one thousand yards, near to Sanna's Post. We saw him thirty hours later. He was then in but little pain, had a quiet pulse of about 90, and had not been sick. The belly was not distended, urine had been passed, and there was no flatulence. The bullet had entered in the middle of the sacrum and had emerged two inches above the pubes, and about one inch to the left of the middle line. With the exception of teaspoonful doses of water no food had been taken, and a little morphia had been administered. As the patient showed no symptoms of injury to the bowel or the bladder, no further treat-

ment was adopted, and three days later he was sent to the Portland Hospital in a bullock-cart, being very little the worse for the long rough journey. He made an uninterrupted recovery, except for a curious and alarming attack three weeks later. He had been most carefully fed, and was only just beginning to take a more solid diet, when about ten one morning he was seized with sudden abdominal pain. He became faint and ill, and his pulse rose to 130 by the afternoon. The abdomen was, however, only a little distended, there was no sickness, and abdominal respiration was maintained. He was treated with morphia injections, and all food was stopped, and, although for the next eighteen hours he gave us much anxiety, and we fully expected to have to perform laparotomy, recovery was ultimately complete and permanent."

Many other cases similar to this have been described by various surgeons, and because of these experiences it has become the general opinion that where there are no symptoms of perforation of the bowel operation should not be undertaken.

This attitude of inactivity, however, must not be considered as equivalent to abandoning altogether the idea of operating if symptoms arise which afford definite evidence that the bowel is probably injured, and we are strongly of the opinion that the attitude of the surgeon should be identical with that generally advocated when a patient in civilian practice has met with contusion of the abdomen of such a nature as to make it not improbable that visceral injury has resulted. Under these circumstances it is now the practice to regard with the utmost watchfulness the development of diagnostic symptoms, and, if it appear probable that there is a rupture of the intestine, laparotomy is at once resorted to.

We consider that this is the correct attitude to assume in cases of bullet wounds of the abdominal cavity also, if the conditions are such as to justify operation at all, and the following symptoms will generally be noted as indica-

tions that the bullet wound has opened the cavity of the bowel, and is being followed by commencing peritonitis.

Perhaps the most reliable early symptom is a steadily rising pulse, and there are very few cases indeed in which the pulse rate is not definitely and steadily increased from hour to hour when mischief is brewing. Associated with this is an increasing hardness and fixity of the abdominal wall; but it is to be noted that this at first is never associated with distension of the abdomen, but rather with retraction. Distension is a much later condition, and should never be waited for. The amount of pain complained of depends so much on the temperament of the individual that it is not a safe guide, but it often is very severe, and may amount to real agony if matters have gone on to general peritonitis. Strictly localised tenderness does not indicate a wound of the bowel, and may well be associated with the wound of merely the abdominal wall; but a rapidly increasing area of tenderness is an important diagnostic sign. The absence of liver dullness, due to air in the peritoneal cavity, is an important indication at an early stage, and before distension of the abdomen has supervened; but when there is much gas in the intestine, it is difficult to accurately percuss out the liver dullness The presence of the ordinary area of hepatic dullness in no way negatives the diagnosis of perforation of the bowel, for in many such cases the liver dullness remains unaltered.

Sickness, which may be very frequent, is a very important symptom when present; but its absence is not in any way indicative of the immunity of the intestine. Finally, the passage of flatus is early arrested in commencing peritonitis, and constitutes an important symptom.

In any case which is left till general peritonitis is advanced, the condition of the patient is usually only too evidently hopeless. The weak, running, or uncountable pulse, the tumid abdomen, the constant sickness, and the evident collapse, indicate that the time has passed

when operation can be of help, and one can only assist the patient to die in peace by the administration of morphia.

Our own opinion is, therefore, that in perforating wounds of the abdomen it is not to be assumed that the intestine has been injured until symptoms indicative thereof supervene, and that then, as soon as a diagnosis is arrived at, laparotomy should be performed. If wounded bowel is discovered, it may either be sutured, or, if necessary, excised, and other conditions must be dealt with on general surgical principles.

We are, however, only too well aware that it will but seldom happen in actual warfare that the opportunity of operation will be afforded. Nevertheless, we have no doubt that it might have been occasionally resorted to with advantage in South Africa under reasonably favourable circumstances, and we are aware of cases which would have been so treated but for the too favourable opinions of the course of such injuries which were generally prevalent.

Bullet Wounds of the Bladder.

These have, on the whole, done well, and that, in many cases, despite a temporary urinary fistula. Extravasation of urine and cellulitis seem to have been of rare occurrence, and, unless complicated by wounds of the intestine, the majority of these patients have recovered. The experience of American surgeons in Cuba and the Philippines seems to have been similarly favourable. The only treatment requisite seems to be the tying in of a catheter, and, if necessary, the opening up of the wound to admit of the easier escape of urine, and, in some cases, the making of incisions where cellulitis and extravasation have supervened.

Non-Penetrating Wounds of the Abdomen, and Contusion.

Oblique, non-penetrating wounds were very common, but they never, in our experience, caused any special trouble, and healed quite as well as wounds of the extremities, in spite of the constant movement of the abdominal wall.

Contusion of the abdominal wall by shell fragments in some cases caused rupture of the viscera, and in two patients who were under our care the shell contusion had caused abdominal pains, which persisted for many weeks, and were no doubt due to injury of the viscera without there being any serious damage.

Mr Watson Cheyne has recorded one very curious case of injury of the intestine by a bullet which did not perforate the skin, and says: "A man was wounded in the fight of April 1st, three days before I saw him. A spent bullet struck the abdomen just to the right of the umbilicus, but did not penetrate the skin. He became much collapsed, and when I saw him was in the last stage of suppurative peritonitis. He died a few hours later. On post-mortem examination rents were found in two adjacent coils of the small intestine. In one, it was about an inch in length, clean cut, and went transversely through all the coats. In the other, it was as if a knife had been drawn obliquely across a wrinkled intestine, so that in three places in its course it divided the serous coat alone, while at one end all the coats were penetrated. Where the bullet struck the skin there was a small slough still firmly adherent, and underneath it a cavity containing pus, gas, and sloughing tissue, which communicated with the peritoneal cavity by a minute opening." Such cases are fortunately rare, but the possibility of their occurrence must be borne in mind.

CHAPTER XVI

MISCELLANEOUS SURGICAL CASES

THE first thought of a civilian who contemplates work in a war hospital is of wounds. It escapes his notice that it is not possible to have a large army—of picked men it is true—without many surgical complaints, and that a large part of his work will be to attend to diseases and injuries with which he is familiar in civil practice.

Work at a Base Hospital certainly soon impresses this on one, and, in the intervals of fighting, convoys still arrive from the front with all sorts of ailments and injuries. The following were among the cases with which we had to deal: Scalp wounds, sprains, contusions, fractures of various bones, scorpion bites, injuries from barbed wire and corrugated iron, etc.

The treatment of surgical injuries and diseases needs no description here, as it differs in no respect from that employed in times of peace.

There are one or two considerations that must be remembered when the question of expediency operations come to be considered. It must be distinctly borne in mind that the function of a war hospital is to relieve suffering and to restore as many men to a fighting condition as possible.

No operation should then be undertaken which does not conduce to a rapid return of the patient to the front, unless the withholding of such operation is detrimental to the health of the patient.

Expediency operations, such as those for radical cure

of hernia or of varicose veins, mean that so many beds will be blocked for a certain length of time, whereas one of the chief duties of a hospital is to keep itself as empty as possible, so that in the event of the arrival of a large number of sick and wounded they may be suitably housed.

The following case is of interest as showing how trivial an injury may bring into hospital one who had long escaped the more obvious perils of war :—

A. H. was a private in the Mounted Infantry, and before coming to South Africa had gone through two campaigns, and had not slept under a roof for two years. He saw a good deal of fighting during the first three months of the war, and was laid low in the following way. In a skirmish he happened to be on horseback near some barbed wire, when the beast was shot under him, and in falling he scratched his hands on the spikes of the wire. For some reason barbed wire is very unpleasant material with which to be wounded: possibly the friction against the hides of the cattle poisons it, but the fact remains that such wounds are extremely likely to become infected. It was so in this case, and the arms of the patient became quickly swollen and painful, and necessitated his removal to hospital. It was many weeks before he was able to rejoin his regiment.

It is soon borne in upon one that the human body is liable to many structural defects, and after seeing numerous cases of hernia, varicose veins, hammer-toe, etc., arrive at the base, one is inclined to wonder how many perfect men exist in any hundred persons walking the streets at home.

The army is filled with men who, if not picked for their physical beauty, are at least chosen because of the absence of bodily defects, and should therefore contain fairly normal men. This, however, is not altogether the case, and there are two explanations—either that such defects escape the eye of the examining officers, or that they occur or become more pronounced under the stress and strain of war. We

are inclined to think that the last is the correct supposition in the majority of cases, to judge from the amount of work thrown on the civilian hospitals at home by would-be recruits for the army.

It is often a matter for thought whether, if the human race were to return to its primitive manner of living, there would be sufficient differences between individuals to allow the theory of selection to work, and the presence of so many defects seems to return an answer in the affirmative.

Looking at the question from a practical point of view, the large number of men thus invalided point out the necessity for a very stringent medical examination of all troops leaving for the front. There is no doubt that, in the bustle of calling up and fitting out men, many were passed who were better left at home, and this was especially the case among the reservists.

Men likely to knock up, whether from disease or physical defect, will be an encumbrance to the army, and their retention will lead to extra work for the medical department, and also to unnecessary suffering not only to the weakly ones themselves, but also to others, who will be deprived of a certain amount of comfort and attention.

A few words about the surgical diseases that came under our notice may not be out of place, as showing what must be expected even in time of war.

We saw a very small amount of venereal disease. Syphilis in both the secondary and tertiary stages came under notice, and among the latter we had one case of fatal gummatous meningitis. The secondary syphilis was the result of infection at home, the disease having again become evident from the absence of treatment at the front. The patients with gonorrhœa had acquired it in South Africa while the troops were stationed at Cape Town or its neighbourhood.

The remote consequences, also, of this affection were seen, and one patient with stricture showed how persistently some men will conceal sickness with the idea of

remaining at the front or getting back there. The case was that of a man who landed in the country with a stricture that already gave him much trouble; but he proceeded to the front, and took part in several engagements, in the last of which he was wounded and sent to the base. The wound was a flesh one and quickly healed, but the stricture became much worse, until one day the urethra ruptured and extravasation took place. Even then the man concealed the fact, and it was not till almost forty-eight hours afterwards that he reported his condition. When asked why he had acted so foolishly, he replied that he wanted to get back to the fighting, and was afraid that if he reported it he would be stopped.

Hæmorrhoids seemed rather more common than would have been expected, considering the life that the troops led. Most of the cases that came under our care occurred in the infantry, and possibly the dry climate and the absence of wet saddles accounted for its comparative absence in the mounted branch of the service. The causation of piles among the infantry must be accounted for by the constant marching, and by the fact that the exigencies of a campaign are not always conducive to a regular action of the bowels.

Several cases of old-standing suppurative middle-ear disease came into the Portland Hospital, and in one the disease was double and the man stone deaf, an affection which has obvious drawbacks in a private soldier at the front. None of the more serious complications of this disease were treated, but it would have been wiser to have retained such men at home.

Cases of malingering do occur, but are rare, and the question arises as to how such cases are to be dealt with. First, there is the extreme difficulty of deciding whether the man is really shamming, or whether he is not the subject of neurasthenia, or has some undiscoverable disease. Under the circumstances we did not think it worth while sending a suspected case back to the front, and considered that the better course was to recommend such cases for

duties at the base, where medical aid would be at hand if more definite symptoms occurred.

If the man is sent back to the front, it having been determined that he is malingering, he will only go sick at the first available opportunity and again come on the medical officer's hands. We heard of one man who had been in the country for two months, and had only spent about a day on duty in all that time, the remainder being divided between the Field, Stationary, and Base Hospitals. When he came under our care there was nothing definitely wrong on which one could put one's finger.

"Veld sores" is an affection with which any one who has lived out on the South African veld for any length of time must be acquainted; indeed, there are not many people who have led such a life who have not, at one time or another, been its victims. The sore usually starts in a wound of the cuticle, which refuses to heal, and becomes covered with a yellowish-brown scab. If left to itself it shows little disposition to heal, but rather to spread. If the scab is taken off it leaves a raw surface, and the edges of this surface are surrounded with a white undermined skin. Its usual situation is the back of the hands and fingers, and the patches are locally infective, multiple, and have a tendency to coalesce. It also appears on the face, but then generally after the hands are infected, so that it is very likely to have been inoculated into the face by the hands. On the legs it affects the extensor surface most, and here is often very troublesome and likely to leave scars of white atrophied skin. A good idea of its appearance is seen in Plate XLIX. Many men were invalided with these sores at one time or another, and sometimes they were kept off duty by them for several weeks.

The general appearance of each sore closely resembles that of an ecthyma pustule, and the disease certainly suggests an infective origin, resembling some cases of impetigo, as there is no heaping up of the scab. It yields easily to such ointments as ammoniated and dilute nitrate of mercury.

VELD SORES.

[*To face page* 292.

We had no cases of suppurative periostitis due to enteric fever, but amongst the surgical conditions complicating this disease we might specially mention two cases.

In one of these the patient suffered from a very severe and acute arthritis of the right hip joint, and from a milder attack of inflammation of the knee on the same side. We saw him first in one of the military hospitals at Bloemfontein at a time when the slightest movement of the limb caused the acutest pain, and it was only after several weeks, with weight extension and a splint, that he was able to be moved to England. We have seen him several times since with Sir Thomas Smith, and although the knee has become movable and useful, after breaking down adhesions under an anæsthetic on several occasions, the hip joint is apparently firmly anchylosed and fixed by new bone.

In the next case, a patient, who had recently suffered from enteric fever and was in the convalescent stage, was admitted into the Portland Hospital at Bloemfontein with a large swelling in the right iliac fossa, feeling like an abscess. An incision was made through the abdominal muscles, and a large quantity of pus was liberated from behind and around the cæcum and the appendix. It seemed to be a case of appendicitis occurring in the course of typhoid fever, and we thought it might have resulted from a typhoid ulceration of the appendix, such as that already described as occurring in another case.

We had many opportunities of observing the course of wounds in patients suffering with typhoid fever, and it never seemed to us that the course of these wounds was at all influenced by the concurrent disease. In some cases typhoid fever developed some time after the patient had come under treatment for the wound, but at other times men went on marching and fighting with typhoid fever upon them until they were fortunate enough to be disabled by a bullet, and thus forced to go into hospital.

The pluck and determination of the men, indeed, made it all the more difficult to arrest the spread of the epidemic.

Men and officers alike, they would not go sick so long as they could stand, or could sit on a horse. The spirit was truly admirable, but it brought troublesome complications in its train. It was indeed quite wonderful to note the splendid obstinacy with which men would stick to their duties in spite of the manifest discomfort of wet camps and short rations, and with the temptation of a comfortable bed in hospital near at hand. On one occasion a private came to our camp at Bloemfontein with a note, saying that the man had become so deaf that he could not hear orders given to him. He had walked a mile with the message, and stood at attention whilst the letter was read. On inquiry, he said he had not gone on the sick list, and was still doing his regimental duty, but admitted he had not been feeling very well for more than a week. A very few minutes' examination revealed that he was well advanced in enteric fever, to which his deafness was due, and that his temperature was 104°. We put him straight to bed, and did what we could for him, but it is sad to record that he died ten days later, a victim to his own determination to do his work, and not go sick if he could help it at a time when the advance to Pretoria was imminent. It is impossible to speak in terms of sufficient enthusiasm of such devotion to duty.

APPENDICES

APPENDIX A.

MEDICAL AND SURGICAL STAFF OF THE PORTLAND HOSPITAL.

ANTHONY BOWLBY, F.R.C.S., Senior Surgeon.
HOWARD TOOTH, M.D., F.R.C.P.
CUTHBERT WALLACE, M.B., B.S., F.R.C.S.
JOSEPH CALVERLEY, M.B., B.S., M.R.C.S.

Surgeon-Colonel KILKELLY, Grenadier Guards, Principal Medical Officer, and in Military Charge.

Nursing Sisters.

Miss PRETTY.	Miss A. M. DAVIES.
Miss COX-DAVIES.	Miss FRANCES RUSSELL.

Chief Wardmaster	S.-Sgt. NOBLE, R.A.M.C.
Steward and Compounder . .	Sgt. FARRELL, R.A.M.C.
Assistant do. and Office . .	S.-Sgt. PEAT, S.J.A.B.
Pack Store and Sanitary Duties of Camp	S.-Sgt. EVANS, S.J.A.B.
Assistant Compounder . . .	S.-Sgt. MACNAMARA, S.J.A.B.
Master Cook—Hospital . . .	S.-Sgt. SAYER, S.J.A.B.
Chef for Officers' Mess and Sick Officers	W. A. SCETTRINO.
Chef for Sick Officers in Hospital .	G. T. EVANS.
Provision and Linen Store . .	Pte. BOYD.
Assistant Cook	Pte. BUSHELL.
Assistant in Pack Store . . .	Pte. BOTTERILL.
Office Orderly	Pte. COLLINS.
In Charge of Transport . . .	Pte. MITCHELL.

Section A.—Sister DAVIES.

Ward 1 Orderly, Pte. BLEASDALE.
" 2 " Pte. STRATFORD.
" 3 " Pte. HOLLOWAY.

Section B.—Sister COX-DAVIES.

Ward 4 Orderly, Pte. RYAN.
" 5 " Pte. NEWNES.
" 6 " Pte. COMPSTON.

Section C.—Sister RUSSELL.

Ward 7 Orderly, Pte. HARNESS.
" 8 " Pte. SQUIRES.
" 9 " Pte. POTTINGER.

Section D.—Sister PRETTY.

Ward 10 Orderly, Pte. HARPER.
" 11 " Pte. ELLIS.
" 12 " Pte. PALLETT.

Enteric Ward, No. 16.

Sisters CARSTON and GODFRAY, New Zealand, temporarily attached for night duties.

Orderlies, Ptes. MARCHANT, MOORE, and HARRIS.

Enteric Ward, No. 18.

Sister HARLAND.

Orderlies, Ptes. BORER and MATTHEW.

21 *Convalescent Tent.*—Ward No. 13.

Orderly, Pte. WILSON.

Operating Theatre and Photo Tent.

Orderly, Pte. FREEMAN.

In Charge of Enteric Linen.

Pte. JOHNSON.

Officers' Servants.

Pte. BARNES (Grenadier Guards).
S. MARKER (afterwards Messman).
MATILDA CLUTTON (to Nurses).
I. COLLINS.

Rates of Pay.

4 Supernumerary Officers, St J.A.A.	£1	18	6	weekly.
12 First Grade Orderlies	1	3	6	"
12 Second Grade Orderlies	1	1	6	"

"Extra Duty" pay, at 4d. daily, was given to some for certain extra duties.

"Extra Messing" Allowance, 4d. daily, was given to each N.C.O. and man to improve their messes.

One month's gratuity on termination of contract services, increased later to two months.

APPENDIX B.

FORMS OF CONTRACT.

To the Committee of the Portland Hospital (*Red Cross*).

I, A. B. C.,

of A. B.,

hereby offer to serve as a Nurse to Her Majesty's Forces in South Africa on the following conditions :—

1. The period of my service hereunder shall commence as from the day on which I shall embark from England, and shall continue until the expiration of six calendar months thereafter, or until my services are no longer required, which ever shall first happen.

2. My pay shall (subject as hereinafter appears) be at the rate of £40 per annum, and a gratuity of £20 at the expiration of my services.

3. In addition to such pay, I shall receive a free passage from England to South Africa, and (subject as hereinafter appears) a similar free passage from South Africa to England at the end of the said period ; and I shall be put to no expense for maintenance, rations, or transport during such period.

4. During the said period I will devote my whole time and professional skill to my service hereunder, and will obey all orders given to me by Commissioned Military or Naval Officers, or by the Permanent Medical Officers of either of those Services, or others who may be appointed as my superior officer or master.

5. In case I shall in any manner misconduct myself, or shall be (otherwise than through illness or unavoidable accident) unfit in any respect for service hereunder, of which misconduct or unfitness the Military Authorities, or those in charge of the Portland Hospital, shall be sole judges, you shall be at liberty from and immediately after such misconduct or unfitness to discharge me from further service hereunder, and thereupon all pay and allowances hereunder shall cease, and I shall not be entitled to any free passage home.

6. In the event of my death or injury by accident or otherwise, neither I nor my relatives or others shall have any claim whatsoever against the Committee or otherwise in respect to my decease or injury.

Dated this 6th day of December 1899.

A. B. C. (here sign).

Witness to the signature of the said D. E. (Witness).

On behalf of the Committee of the Portland Hospital I accept the foregoing offer. (Signed) PORTLAND.

FORMS OF CONTRACT—*Continued.*

To the Committee of the Portland Hospital (Red Cross).

I, A. B. C.,

of A. B.,

hereby offer to serve as a First Grade Orderly to Her Majesty's Forces in South Africa, and make myself generally useful, on the following conditions :—

1. The period of my service hereunder shall commence as from the day on which I shall embark from England, and shall continue until the expiration of six calendar months thereafter, or until my services are no longer required, which ever shall first happen.

2. My pay shall (subject as hereinafter appears) be at the rate of 30s. per week.

3. In addition to such pay, I shall receive a free passage from England to South Africa, and (subject as hereinafter appears) a similar free passage from South Africa to England at the end of the said period ; and I shall be put to no expense for maintenance, rations, or transport during such period.

4. During the said period I will devote my whole time and professional skill to my service hereunder, and will obey all orders given to me by Commissioned Military or Naval Officers, or by the Permanent Medical Officers of either of those services, or others who may be appointed as my superior officer or master.

5. In case I shall in any manner misconduct myself, or shall be (otherwise than through illness or unavoidable accident) unfit in any respect for service hereunder, of which misconduct or unfitness the Military Authorities, or those in charge of the Portland Hospital, shall be sole judges, you shall be at liberty from and immediately after such misconduct or unfitness to discharge me from further service hereunder, and thereupon all pay and allowances hereunder shall cease, and I shall not be entitled to any free passage home.

6. In the event of my death or injury by accident or otherwise, neither I nor my relatives or others shall have any claim whatsoever against the Committee or otherwise in respect to my decease or injury.

Dated this 5th day of December 1899.

A. B. C. (here sign).

Witness to the signature of the said D. E. (Witness).

On behalf of the Committee of the Portland Hospital I accept the foregoing offer. (Signed) PORTLAND.

APPENDIX C.

SCALE OF CLOTHING FOR ORDERLIES.

1 Great Coat.
1 Serge Suit, Khaki.
1 Drill Suit, Khaki.
1 Helmet and Field Service Cap.
2 pairs Boots.
3 Blankets.
2 Towels.
2 pairs Drawers.
2 pairs Socks.
1 pair Putties.
1 pair Braces.
2 Flannel Shirts.
1 Haversack.
1 pair Canvas Shoes.
1 Holdall, with Knife, Fork, Spoon, Razor, Brush.
1 Jersey.
1 Mess Tin.

APPENDIX D.

MENU.

Menu of Queen's Birthday Dinner, 24th May.

Soup—Julienne.
Lamb Cutlets. Green Peas.
Sirloin of Beef.
Roast Venison.
Fruit Tart. Cheese Straws.

PORTLAND HOSPITAL.

Menu.

BREAKFAST

LUNCHEON

DINNER

BLOEMFONTEIN. *Date*..............................

APPENDIX E.

ARMY "HOSPITAL DIETS" AND "EXTRAS."

VII.—*Hospital Rations.*

n ordi- rvice.

54. Except at stations abroad where special scales are in force, which are detailed in the local regulations of the station, issues will be made to the patients specified in paragraph **65** in accordance with the following scales, according to the diet upon which each patient may be placed :—

(*a*) DIETS.

Article.	Class of Diet.						
	Varied.	Roast.	Convalescent.	Chicken.	Beef-Tea.	Milk.	Plain Milk.
Meat (Beef or Mutton) without bone . ozs.	12	8 (steak)	8	half a fowl	8 (beef)		
with bone . . . ,,	15	10 (chop or joint)	10		10 (beef)		
Bread . . . . . . ,,	18	18	16	16	14	12	
Salt . . . . . . ,,	½	½	½	½	½		
Tea . . . . . . ,,	¼	¼	¼	¼	¼		
Sugar . . . . . . ,,	1½	1½	1¾	1½	1½	1	
Milk . . . . . . ,,	6	6	6	6	6	3 pints	3 pints
Butter . . . . . ,,	1	1	1	1	1		
Potatoes . . . . . ,,	16	8	8	8			
Vegetables . . . ,,	4	4	4				
Flour . . . . . . ,,	...	...	¼				
Barley . . . . . ,,	...	...	1½				
Rice . . . . . . ,,	...	...	...	...	...	2	
Pepper (every 100 diets . . . . . ,,	2	2	2	2	2		
Mustard (every 20 beef diets) . . . ,,	1	1	1				

Extras.

55. Extras to be ordered when considered necessary for the treatment of the case.

Extras.	Class of diet upon which admissible.
Butter, Bread; Eggs, Arrowroot; Milk, Sago; Tea, Oatmeal; Sugar, Beef-tea, Egg flip; Rice, Sago, Custard pudding; Soda Water; Lemonade, bottled; Calf's foot jelly; 4800/3/142 Customary fruits in season; White fish, 12 ozs. gross weight; Butter, 2 ozs.	All diets except varied.
Potatoes, 8 ozs., or Vegetables, 4 ozs.	Upon beef-tea diet when it is found necessary to keep a patient on this diet for any lengthened period, or when there is a tendency to scorbutic taint.
Flour, ⅛ oz.	Upon varied, steak and chicken diets when ordered by the medical officer to be stewed.
Wines * (Sherry, Port, Tarragona, Claret); Spirits * (brandy, whisky, gin); Malt liquors (stout, ale); Diet drinks: Barley water, Rice water, Gruel, Lemonade	Upon all diets, including varied.
38407/Medical/162 Other articles, in addition to above	For officers' diets, or in exceptional cases, as considered necessary by the senior medical officer.

Ingredients.

56. When any of the extras specified in paragraph **55** are ordered, they will be made and charged according to the following proportions:—

Barley-water—barley, 2 oz.; sugar, 2 oz.
Rice-water—rice, 2 oz.; sugar, 2 oz.
For every 5 pints of each.

Measure of liquids.

* Milk, wines, and spirits are to be calculated at 20 oz. the Imperial pint. The reputed quart bottle should contain 5⅓ gills, or 26⅔ oz.

Lemonade—two large lemons and $1\frac{1}{2}$ oz. of sugar
Gruel—oatmeal, 2 oz., and $1\frac{1}{2}$ oz. of sugar
} to every 2 pints.

Rice-pudding—rice, 2 oz.; milk, $\frac{3}{4}$ pint; sugar, $\frac{1}{2}$ oz.; egg, 1.

Sago-pudding—sago, $1\frac{1}{2}$ oz.; milk, $\frac{2}{3}$ pint; sugar, $\frac{1}{2}$ oz.; egg, 1.

Custard-pudding—milk, 1 pint; sugar, 1 oz.; eggs, 2.

Cinnamon, $\frac{1}{2}$ oz. may be issued for 15 puddings, or one lemon to 12 puddings.

Oatmeal, 4 oz.; with milk, 8 oz.

Arrowroot, 2 oz.; with sugar, 1 oz.

Sago, 2 oz.; with sugar, 1 oz.

Egg flip; 2 eggs with $\frac{1}{2}$ oz. sugar.

Tea, per pint; $\frac{1}{8}$ oz. tea; $\frac{3}{4}$ oz. sugar; 3 oz. milk.

Beef-tea, per pint {
$10\frac{2}{3}$ oz. meat without bone.
$13\frac{1}{3}$ oz. meat with bone.
$\frac{1}{2}$ oz. extractum carnis.
4 oz. essence of beef.
With pepper and salt as required.

57. The following rates will be allowed for substitutes:— Substitutes.

2 oz. lime juice = 1 lemon.

3 oz. rice, or
3 oz. flour, or
8 oz. bread
} = 16 oz. potatoes.

1 oz. preserved potatoes = 5 oz. fresh potatoes.

1 oz. preserved vegetables = 10 oz. fresh vegetables.

$\frac{1}{2}$ oz. coffee = $\frac{1}{6}$ oz. tea.

1 tin condensed milk = $2\frac{1}{4}$ pints.

On active service.

58. On active service, in general hospitals at the base, and in stationary hospitals on the lines of communication, the scale of diets laid down in paragraph **54** will be followed as far as practicable, and any deviations found necessary, on account of the position, climate, or the supplies obtainable, will be sanctioned by the general officer commanding, on the advice of the principal medical officer. If a special hospital for officers is formed on active service, the scale of issues will be such as from time to time may be ordered by the Secretary of State, or by the general officer commanding in anticipation of his authority.

When soldiers are only temporarily treated.

59. In the event of a soldier not being likely to require treatment beyond that of the day on which he has reported himself sick, he will be detained in the hospital for that day only and subsisted from his unit, to which he will return if considered fit for duty; but if at the evening visit he is found unfit for duty, he will be regularly admitted and placed on hospital diet for the following day, notice to that effect being sent to the officer commanding his unit.

(*b*) AN ARMY DIET SHEET.

__________________*Hospital, at*__________________ *Month of*__________________189___

DIET SHEET OF	RANK AND NAME.	Corps.	Regtl. No.	Squadron, Troop, Compy., or Battery.	Age.	DISEASE.

Ward No.	Number in Admission and Discharge Book.	Admitted into hospital.	Discharged from hospital.	CASE BOOK, Vol. page
		__________189	__________189	Religious denomination }*

If allowed up, the hours, and if fit for light hospital duty, state so.	Date.	Diet, first time name in full, afterwards by initials.	DIET DRINKS. Quantities in words.			EXTRAS. Quantities in words.									Initial of Medical Officer (first time, name in full). All spaces in which no entries have been made must be severally obliterated by the Medical Officer thus______ before he signs his name or initials.
	1														
	2														
	3														
	4														
	5														
	6														
	7														
	8														

9														
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23														
24														
25														
26														
27														
28														
29														
30														
31														
TOTAL IN FIGURES.														

I certify that the above Diets, Drinks, and Extras were prescribed by me solely for the use of the above-named Patient, for whom I consider them absolutely necessary.

____________________ *Medical Officer in Charge.*

Diets and Extras to be filled in daily by the Prescribing Medical Officer, and on discharge of a patient a diagonal line to be ruled from last day's Diet to right hand lower corner. The date of discharge is invariably to be filled in by Prescribing Medical Officer. No erasures to be made on this Form ; any alterations of Diet or Extras prescribed must be in the handwriting of the Prescribing Medical Officer, and initialed by him.

* "Church of England," "Presbyterian," "Wesleyan," "other Protestants not included in the foregoing." "Roman Catholic" or "Jews," according to the class to which the patient belongs.

(*c*) AN ARMY "SUMMARY OF DIETS."

Diet and Extra Sheet Summary.

Ward No. ____________ Division No. ____________

Date ____

Description of Diets.	No.
VARIED — Roast . .	....
VARIED — Stewed . .	....
ROAST — Joint	....
ROAST — Chop	....
ROAST — Steak — Roast . .	....
ROAST — Steak — Stewed . .	....
CONVALESCENT . .	....
CHICKEN — Roast .	....
CHICKEN — Boiled .	....
CHICKEN — Stewed .	....
Beef-Tea	....
Milk	....
Plain Milk . . .	....
Total . .	

Extras and Drinks.		Quantity.
Lemonade . .	pts.	....
Barley Water . .	,,	....
Gruel . . .	,,	....
....		....
Beef-Tea . . .	,,	....
Puddings — Rice . . .	No.	....
Puddings — Sago . . .	,,	....
Puddings — Custard . .	,,	....
Fruits, Oranges .	,,	....
....		....
Fish . . .	ozs.	....
....		....
Milk . . .	pts.	....
Eggs . . .	No.	....
....		....
Wines, Port . .	ozs.	....
,, Sherry . .	,,	....
Soda Water . .	bots.	....
Porter, draught .	pts.	....
,, bottles . .	,,	....
Ale, draught . .	,,	....
,, bottles . .	,,	....
Brandy . . .	ozs.	....
Whiskey . . .	,,	....
Gin	,,	....

Signature of :—

Orderly ____

Wardmaster ____

(*d*) DIET TABLE DEVISED FROM RATIONS AND EXTRAS ON THE FIELD AT BLOEMFONTEIN.

Portland Hospital—Diet Table.

MILK.	BEEF-TEA.	SOUP RATIONS.	MINCE RATIONS.	RATIONS.	
Milk, 4 pints.	Bovril, 3 pints.	Ration meat made into Soup. Vegetables.	Ration meat made into Mince. Vegetables.	Meat, $1\frac{1}{4}$ lb. Vegetables.	Extras as ordered on any diet, and at any time.
Bread, 12 ozs.	Bread, 1 lb.	Bread, 1 lb.	Bread, 1 lb.	Bread, $1\frac{1}{4}$ lb.	
Sugar, 1 oz.	Sugar, 2 ozs.	Sugar, 2 ozs.	Sugar, 2 ozs.	Sugar, 2 ozs.	
Tea, 3 pints.	Tea, 3 pints.	Tea, 3 pints.	Tea, 3 pints.	Tea, 3 pints.	

MEAL.	MILK.	BEEF-TEA.	SOUP.	MINCE.	RATIONS.	
Breakfast.	Milk and Bread.	Tea, Bread and Butter.	Tea, Bread and Butter.	Tea, Bread and Butter.	Tea, Bread and Butter.	Extras as ordered.
Dinner.	Milk and Rice.	Beef-Tea.	Soup and Bread. Vegetables.	Mince. Vegetables.	Meat, Vegetables, Rice.	
Tea.	Milk and Bread.	Tea, Bread and Butter.	Tea, Bread and Butter.	Tea, Bread and Butter.	Tea, Bread and Butter.	
Supper.	Milk.	Omelette.	Omelette.	Omelette.	Omelette.	

EXTRAS.

Breakfast.	Dinner.	Tea.	Supper.
Cocoa.	Fruit Tarts.	Biscuits.	Soup.
Oatmeal.	Preserved Pears.	Rasin Wine.	Rice } Puddings.
Herrings.	Bovril } To be added to Stock Soups.	Butter } when available.	Sago } Puddings.
Bloaters.	Packet Soups } To be added to Stock Soups.	Eggs } when available.	Ovo } Puddings.
Kippers.	Milk or Beef-Tea, as ordered.	Jams.	Drinks { Lemonade.
Haddocks.	Chicken.		Drinks { Soda Water.
Sardines.	Turkey.		Drinks { Wine as ordered.
Butter } when available.	Fish.		Jelly.
Eggs } when available.	Venison.		Milk or Beef-Tea, as ordered.
Jams.	Cheese.		
	Fruits in season.		

Bloemfontein.

C. R. KILKELLY,
Surgeon-Colonel, Grenadier Guards,
in/c. Portland Hospital.

APPENDIX F.

RULES FOR DISINFECTION OF EXCRETA.

METHOD OF DISINFECTION.

Enteric or Infectious Stools.—1. The bedpan *to contain* $2\frac{1}{2}$ oz. bichloride solution, 1 *in* 250. This solution will be issued from the surgery to the respective wards as ordered by the medical officer.

2. The stool will then be *covered* with chloride of lime, also obtained from surgery.

3. The bedpan, *covered* by a cloth soaked in carbolic lotion, 1 *in* 40, will then be taken to the latrine and emptied into a bucket marked E in *red letter*, and *covered.*

4. The bedpan will then be washed out, *at the latrine*, with carbolic lotion, 1 *in* 15, and the washings added to the bucket marked E. The orderly will then wash his hands with carbolic lotion, 1 *in* 40, soap and water, and dry his hands *on his own towel at the latrines.*

5. Urine will also be treated in the same way and emptied into urine bucket marked E. The buckets will be emptied twice daily under arrangements made with the sanitary officials, or the contents may be boiled and emptied into pits.

6. *All* slops from washings in wards to be emptied into *slop buckets* provided in each section, and then carried and emptied into *slop pit.*

APPENDIX G.

WATER ANALYSES BY DR TOOTH.

Examination of a Sample of Drinking Water.

From Water supplied to Portland Hospital, 19th May 1900.

Source and Possibility of Contamination. Said to be from Modder River Waterworks. Many of the joints of the delivery tube are defective.

Chemical and Physical Examination.

1. Colour in 6-in. column.	Distinct yellow tinge.
Turbidity.	Very considerable, not increased on boiling.
2. Odour.	None.
3. Residue left on evaporation.	Very small, yellowish-white, very slight, charring on heating, no smell, dissolves with effervescence with acid.
4. Free ammonia.	None.
5. Chlorine.	Two grains per gallon.
Equivalent of common salt.	Three grains per gallon, about.
6. Nitrites.	A very considerable quantity.
7. Nitrates.	?
8. Hardness.	Somewhat over 4°.
9. Lead.	None.
10. Zinc, iron, and copper.	A distinct trace of iron.
11. Oxygen absorbed in 15 min. at 212° F.	Between ·20 and ·30, with brown discoloration.

Portland Hospital, Bloemfontein, 19th May 1900.

To P.M.O., Bloemfontein.

Dear Sir,—From the examination of the water herein referred to, and the results obtained by analysis, I am of opinion that it should be regarded with great suspicion for drinking purposes.

The abundant evidence of the presence of nitrites and the quantity of oxygen absorbed, in addition to the marked and constant turbidity of the water, point strongly to contamination of the water, either at the source or in transmission.

The analysis is more unfavourable even than that of Bloemfontein spring, of which I had the honour to forward you a copy on 24th April.—I am, yours faithfully,

HOWARD H. TOOTH, M.A., M.D., F.R.C.P.

EXAMINATION OF A SAMPLE OF DRINKING WATER.

From Bloemfontein Main, 4th June 1900.

Source and Possibility of Contamination.—The water may still be somewhat contaminated by the stagnant water of the mains.

Chemical and Physical Examination.

1. Colour in 6-in. column.	Very slight tinge of yellow.
Turbidity.	Very slight. None on boiling.
2. Odour.	None.
3. Residue left on evaporation.	Very little, white, no charring on further heating.
4. Free ammonia.	None.
5. Chlorine.	Two grains per gallon.
Equivalent of common salt.	About three grains per gallon.
6. Nitrites.	A doubtful trace, but iron is present.
7. Nitrates.	None.
8. Hardness.	About 9°.
9. Lead.	None.
10. Zinc, iron, and copper.	A trace of iron.
11. Oxygen absorbed in 15 min. at 212° F.	About ·4 grain per gallon, with much brown turbidity.

Portland Hospital, Bloemfontein, 4th June 1900.

The P.M.O., Bloemfontein.

SIR,—From the examination of the water herein referred to, and the results obtained by analysis, I am of opinion that it contains a distinct trace of iron, and this circumstance may partially account for the unsatisfactory result noted in par. 11 of the analysis. The decoloration of the permanganate of potash, and its subsequent brown turbidity, suggests contamination. It is possible that the stagnant water in the mains, of the last month or two, has not yet been completely flushed out.

It is advisable to analyse a sample of water fresh from the reservoir as a control.—I am, yours faithfully,

HOWARD H. TOOTH, M.A., M.D., F.R.C.P.

EXAMINATION OF A SAMPLE OF DRINKING WATER.

From Bloemfontein Waterworks Reservoir, 13*th June* 1900.

Source and Possibility of Contamination.—The possibility of contamination by sewage at the source or above it should be ascertained; also whether any peaty streams flow into the river above.

Chemical and Physical Examination.

1. Colour in 6-in. column.	Very faint tinge of yellow.
Turbidity.	None.
2. Odour.	None.
3. Residue left on evaporation.	White, insoluble in water Very little of it. Does not char.
4. Free ammonia.	None.
5. Chlorine.	About 2 grains to the gallon.
Equivalent of common salt.	About 3 grains to the gallon.
6. Nitrites.	None.
7. Nitrates.	None.
8. Hardness.	Somewhat over 4°.
9. Lead.	None.
10. Zinc, iron, and copper.	? A trace of zinc. A trace of iron.
11. Oxygen absorbed in 15 min. at 212° F.	About ·4 grain to the gallon, possibly more; reaction obscured by brown turbidity.

Portland Hospital, Bloemfontein, 13*th June* 1900.

To P.M.O., Bloemfontein.

From the examination of the water herein referred to, and the results obtained by analysis, I am of opinion that it is of a purer quality than the sample from the main, but there is still a large amount of absorbed oxygen (*v.* test 11).

If the possibility of contamination by sewage or animal matter at the source can be eliminated, this reaction may be attributed to vegetable matter, but under any circumstances the water should be regarded with some suspicion for drinking purposes, and boiling and filtering is advisable.

HOWARD H. TOOTH, M.D., M.A. Cantab, F.R.C.P.

APPENDIX H.

EQUIPMENT.

Marquees, Tents, etc.

14 Tortoise Tents.
16 Square Bell Tents.
2 Latrine Tents.
1 Cooks' Shelter.

More tents were obtained in Africa when the Hospital was enlarged.

Beds and Bedding.

150 2′ 6″ × 6′ 2″ Hospital Beds, double-wove wire.
150 2′ 6″ × 6′ 2″ Hair Matresses.
150 27″ × 18″ Feather Pillows.
100 Pairs Scarlet Blankets.
130 Pairs Brown Blankets.
200 Pairs Sheets.
300 Pillow Cases.
200 Brown Army Blankets.

These were subsequently augmented by the purchase in Cape Town of additional blankets, sheets, and pillows.

Ambulance Waggons, etc.

10 AmbulanceWaggons complete, with cover inside.
2 Stretchers, with cross irons.
2 Stretcher Carriers.
2 Water Cans, with straps.
8 Staples for ditto.
1 Bore Tools.
1 Tin Grease.
5 lbs. Tarred Spun Yarn.
1 Hind Wheel.
1 Fore Wheel.
1 Tin Axle Grease.
4 Stretcher Irons.

Tools.

3 Shovels.
3 Spades.
3 Hand Axes.
1 Cold Chisel.
3 Screw Drivers.
1 Claw Hammer.
1 Notched Screw Driver.
2 Small Screw Drivers.
1 Hand Saw.
1 Tenon Saw.
2 Butcher's Knives.
2 Mallets (Beech)
1 Jack Plane.
2 Gross assorted Screws.

Stationery.

1 Cloth Blotter.	3 Hollow Inkstands.
4 School Slates.	6 MSS. Books.

Games.

3 Backgammon Boards.	5 Sets Dominoes.
3 Sets Men.	18 Dice.
5 Dice Boxes.	

Flags, Ground Sheets, and Sundries.

100 Yards Mosquito Netting.	6 Bunting Flags.
2 Fly Switches.	1 Union Jack.
1 Ground Sheet.	14 Tent Pole Straps.
5 Potato Nets.	12 Tan Sheets.
30 Waterproof Sheets.	5 Black Waterproof Sheets.
3 Flag Staffs.	36 Deck Chairs.

Books.

A small library of books for officers and men was kindly provided by Lady Henry Bentinck.

APPENDIX J.

EQUIPMENT OF A TORTOISE TENT WARD.

To be kept complete from stock.

1 Tortoise Tent, 20 ft. × 24 ft.
8 Beds and Mattresses.
16 Pillows (1 hard, 1 soft).
1 Table, 6 ft. × 3 ft.
2 Cupboards (Packing-Cases).
4 to 8 Bedside Tables.
2 Strips Coir Matting (officers' ward).
8 Strips Japanese Matting (officers' ward).
8 Chart and Diet Boards.
8 Knives, Forks, Spoons (large and small).
8 Plates, enamel ware.
8 Bowls, enamel ware.
8 Mugs, enamel ware.
8 Butter Dishes, enamel ware.
8 Egg Cups, enamel ware.
4 Feeding Cups.
1 set Salt, Pepper, and Mustard Pots.
1 Tea Urn.
2 Milk Cans, with lid.
1 Water Can.
4 Hair Brushes and Combs.
4 Shaving Brushes and Bowls.
2 Looking-glasses.
2 Soap Dishes.
1 Set of Diet Tin Trays, army pattern.
4 Trays.
2 Stores Baskets.
1 Oil Lamp.
1 Candle Lamp.
1 Night Light.
2 Candlesticks.
1 Camp Stool.
3 Chairs.
1 Broom.
1 Scrubbing Brush.
1 Bucket.
1 Slop Pail.
1 Large Pail (to each section).
2 Bed Pans.
4 Urinals and 4 Chambers.
4 Spittoons.
4 Spit Cups.
1 Commode (basket army pattern).
3 Bowls, for dressings.
3 Medicine Glasses.
1 Wine-glass Measure, ℥iv.
2 Thermometers.
4 Wash-hand Basins, enamel.
4 Wash-hand Jugs, enamel.
1 Corkscrew.
1 Tin Opener.
2 Bed Tables.
8 Reading Candles (officers').
Crockery and Glass, if available (officers' mess).
2 Foot Baths.
2 Hip Baths.
1 Knife Board.
1 Pair Scissors.
1 Notice Board.
Allow 2½ Sheets and 4 Blankets to each Bed; keep stock in Hospital Linen Store.

APPENDIX K.

KITCHEN EQUIPMENT.

3 Congo Stoves, and Nest of Pots, 10.
4 Cooking Ranges — 2 Bolinger Swedish, 2 English.
2 Hot-water Boilers.
2 Hot-water Boilers, 6-gallon.
2 Hot-water Boilers, 4-gallon.
1 Steam Boiler, 60-gallon.
3 Stewpans, round.
1 Stewpan, nest of 10, steel.
4 Stewpans, miscellaneous.
2 Stock Pots.
1 Saucepan, iron.
3 Kitchen Pans, iron.
4 Omelette Pans, enamel.
8 Camp Kettles.
1 Grill (iron).
1 Steak Tongs.
15 Dripping Tins.
12 Pudding Dishes.
2 Meat Saws.
2 Meat Mincers, large.
1 Cleaver.
1 Chopper.
6 Knives (kitchen).
2 Forks (kitchen).
2 Flesh Forks.
2 Balances (spring).
1 Scale (spring).
3 Ladles, pint.
4 Long Spoons.
2 Measures—1 gallon, ½ gallon.
2 Colanders.
1 Fine Hair Sieve.
2 Strainers.
2 Toasting Forks.
1 Rolling Pin.
2 Cutting Boards.
1 Egg Whisk.
1 Flour Dredger.
1 Pepper Box.
1 Lamp (50 candle power).
2 Coffee Pots.
1 Salt Box.
20 Pudding Shapes.
1 Nutmeg Grater.
2 Wire Dish-Covers.
2 Jelly Bowls.
2 Fish Slicers.
1 Washing-up Bowl.
4 Hand Basins, enamel.
1 Kitchen Basin.
2 Cupboards (from Packing-cases).
1 Bath, for washing up.

APPENDIX L.

MESS STORES AND MEDICAL COMFORTS.

(18 pairs) = 36 cases.
2 1-lb. tins Pressed Beef.
2 1-lb. tins Spiced Beef.
2 tins S. & K. Puddings.
2 tins Ox Tongues.
4 tins O. M. Sausages.
1 $\frac{1}{2}$-tin Arrowroot.
1 $\frac{1}{4}$-tin Baking Powder.
2 tins Beef Essence.
3 tins Beef Extract.
2 tins Meat Lozenges.
1 tin Albert Biscuits.
1 tin Oaten Biscuits.
6 $\frac{1}{2}$-lb. tins Butter.
2 lbs. P. S. Candles.
3 tins Chocolate Food.
1 bottle Chutney.
2 $\frac{1}{2}$-lb. tins Cocoa Essence.
2 tins Cocoa and Milk.
2 bottles Coffee Essence.
1 $\frac{1}{4}$-lb. tin Curry Powder.
6 $\frac{1}{4}$-lb. tins Sardines.
1 tin Dubbin.
1 1-lb. tin French Plums.
1 1-lb. tin Figs.
1 tin Apricots in Syrup.
1 tin Peaches in Syrup.
16 $\frac{1}{4}$-lb. tins Jams.
12 $\frac{1}{4}$-lb. tins Marmalade.
2 $\frac{1}{2}$ bottles Lime Juice.
4 tins Ideal Milk.
4 1-oz. tins Mustard.
1 tin Quaker Oats.
3 White Pepperettes.
3 tins Plum Pudding.
1 $\frac{1}{2}$ bottle Pickles.
6 tins assorted Potted Meats.
2 2-lb. tins Patna Rice.
2 $\frac{1}{2}$-lb. tins Salt.
2 $\frac{1}{4}$ bottles Worcester Sauce.
1 tablet Carbolic Soap.
1 bar Sunlight Soap.
2 tins (6 each) Soup Squares.
3 tins Maggis Consomme.
3 $\frac{1}{2}$-lb. tins Tea.
3 lbs. Mixed Vegetables.
2 tins Haricot Vert.
2 tins Petit Pois.
2 Tin Openers.
(*Repeat* 18 *times*.)

36 tins Bacon ($64\frac{1}{2}$ lb.)
24 1-lb. tins M. and M. Coffee.
24 tins Brand's Nutrient Powder.
48 tins Bloaters.
48 tins Kippered Herrings.
48 tins Findon Haddocks.
48 tins Sardines.
1 case (2 doz.) Bartlett Pears.
48 tins Chicken Broth.
48 tins Ox-Tail Soup, thick.
48 tins M. Turtle Soup, clear.
48 tins Mutton Broth.

MESS STORES AND MEDICAL COMFORTS—*Continued.*

48 bottles Apples.
48 bottles Raspberries.
48 bottles Red Currants.
9 cases (each 48 tins) Dahl's Milk.
16 tins Dahl's Milk.
100 1-lb. Devon Butter.
16 2-lb. tins Soups.
16 1-lb. tins Chicken Broth.
2 ½-gross boxes Sunlight Soap.
6 doz. tablets Pears' Soap.
28 1-lb. tins Bermuda Arrowroot.
30 1-lb. boxes F Patent Sperm Candles.
100 boxes C. P. N. Lights.
2 cwt. Yellow Soap.
3 Tin Openers.
16 7-lb. tins Best Soft Soap.
3 gross B. & M. Safety Matches.
1 case (2 doz.) Portuguese Figs.
3 cases (4 doz.) bottles Raspberries;
(4 doz.) bottles Red Currants;
(7 doz.) Pepperettes.
1 case (28 lbs.) Ground Coffee, in 7-lb. tins, half Mocha, half Mysore.
28 lbs. Pure Ground Mocha in 7-lb. tins.
6 cases "Bear" Cond. Milk.
1 case (2 doz.) "Ship" Bart. Pears.
2 cases (4 doz.) Kidney Soup.
2 cases (4 doz.) Ox-Tail Soup, thick.
2 cases (4 doz.) Mock Turtle Clear Soup.
2 cases (4 doz.) Kidney Soup.
2 cases (4 doz.) "Tom Tit" Apples.
5 cases "Sledge" Cond. Milk, unsweetened.
1 case Devon Butter.
1 case (2 doz.) Assorted Soups.
1 case (2 doz.) Chicken Broth.
1 case (2 doz.) Pressed Beef.
1 case (4 doz.) Pressed Beef.
1 case (4 doz.) "Signal" Camp Rations.
1 case (4 doz.) "Ship" Ox Tongues.
3 cases (6 doz.) Oxford Sausages.
1 case (50 lbs.) Butter.
1 case (4 doz.) Cocoa and Milk.
1 case (8⅓ doz.) A. G. Sardines.
1 case (2 doz.) "Ship" Apricots.
1 case (2 doz.) "Ship" Peaches.
1 case (8⅓ doz.) Macedoines.
1 case 50 tins Extra Fine H. Verts;
50 tins Extra Fine P. Pois.
3 cases (6 doz.) Sliced Bacon.
1 case (4 doz.) "Sledge" Cream.
1 bundle (3 doz.) 3 boxes A. G. Anchovies in Oil.
1 case (8⅓ doz.) A. G. Royans aux Achards.
1 case (8⅓ doz.) "Signal" Norwegian Sardines.
1 case (8⅓ doz.) A. G. Sardines in Lemon.
1 case (4 doz.) "Ship" Flat Lobsters.
1 case (2 doz.) Johnson's Guavas.
1 case (2 doz.) A. G. Olives.
1 case (2 doz.) A. G. Olive Farcies.
1 case (2 doz.) Nutrient Powder.

MESS STORES AND MEDICAL COMFORTS—*Continued.*

2 cases (each 1 cwt.) Yellow Soap.
3 Iron-handed Tin Openers.
1 case 16 7-lb. tins Best Soft Soap.
2 cases (each ½ gross) Sunlight Soap.
1 case (6 doz.) tablets Pears' Soap.
1 case F. Patent Sperm Candles.
1 case 100 boxes Clark's Patent Night Lights.
1 case (36 tins) Brand's Beef Essence ;
54 2-oz. pots Ship Extract of Meat.
36 boxes Brand's Meat Lozenges.
1 case 18 2-lb. tins Albert Biscuits.
1 case 18 2-lb. tins Oaten Biscuits.
1 case 36 lbs. Price's Sperm Candles.
1 case 54 tins Chocolate Food ;
18 bottles Chutney ;
36 tins Cadbury Cocoa Essence.
1 case 36 bottles Reveille Coffee Essence ;
18 tins Dale's Dubbin.
4 cases Jam, each 6 doz. 1-lb tins.
1 case (6 doz.) Marmalade.
3 cases (3 doz.) "Ship" Lime Juice.
1 case 6 lbs. Mustard ;
18 pint bottles Thega Pickles.
1 case 36 2-lb. Quaker Oats.
1 case 54 1-lb. tins Plum Puddings.
1 case (9 doz.) "Ship" Potted Meats.
1 case 48 6d. tins Cerebos Salt;
36 ½-pint bottles Worcester Sauce.
1 case (56 lbs.) Carbolic Soap.
1 case ¼ gross Sunlight ;
36 tins Soup Squares ;
54 tins Maggis Consommie ;
½ doz. Iron-handed Tin Openers.
1 case 28 1-lb. tins Bermuda Kind Arrowroot.
1 case 18 1-lb. tins Bermuda Kind Arrowroot ;
18 ¼-lb. tins "Ship" Baking Powder ;
18 ¼-lb. tins Curry Powder ;
36 2-lb. tins Patna Rice.
2 boxes, each 28, 1s Perfection Macaroni ;
2 boxes, each 28, 1-lbs Perfection Vermacelli.
1 case 28 2-lb jars A. G. French Plums.
1 case 54½-lb. tins Tea.
1 case (24 lbs.) best Ground Coffee.
1 case, tin-lined, 3600 Cigarettes.
1 case 20 lbs. Capstan Navy Cut, ¼-lb. tins, Mild.
13 cases Vanguard Scotch Whisky.
3 cases (3 doz.) "1869" Brandy.
2 cases (4 doz.) Champagne, Special L'Daloux.
3600 Cigarettes, Egypt.
13½-lbs Capstan Navy Cut (¼-lb tins).
13 doz. Whisky.
3 doz. Cognac.
4 ½-bots. Moet's Special Cuvee de Reserve.

APPENDIX M.

DATES AND RESULTS.

Portland Hospital personnel embarked in the transport *Majestic* at Liverpool, 13th December 1899.

Portland Hospital personnel arrived at Cape Town, 28th December 1900.

Stores disembarked from ss. *Victorian*, 2nd and 3rd January 1900.

Hospital opened and received first convoy at Rondebosch, 8th January 1900.

Portland Hospital handed over patients on 6th April, and entrained for Bloemfontein on 8th April, arriving on 14th April 1900, and received first patients on 17th April 1900 (a total of 11 days).

Portland Hospital handed over patients on 21st July at Bloemfontein. Sailed for England in transport *Canada* on 1st August. Arrived in England on August 18th, 1900 (28 days after handing over patients).

Net result.—183 working days out of a total period of mobilisation of 248 days, 65 being spent in travelling.

1009 cases treated at a net cost of about £10 per head.

APPENDIX N.

TO CALCULATE SICK AND WOUNDED.

Sick equals double peace rates, *i.e.*, 10 per cent.

Wounded equals . . . 6 per cent. $\left.\right\}$ $\frac{1}{3}$ severe. $\frac{2}{3}$ slight.

$\frac{1}{3}$ of sick and wounded are in Field Hospitals.
$\frac{2}{3}$ of sick and wounded are in General Hospitals.
Thus for 100,000 men in the field—

Number of sick . . .	10,000
Wounded	5,000
Total,	15,000

Of these, 5000 are in Field, and 10,000 in General Hospitals.

APPENDIX O.

MEDICAL OFFICERS' KITS (RECOMMENDED).

1 Waterproof Coat.
1 Great Coat, or ("Coat warm British Officers").
2 Serge Khaki Suits.
1 Drill Khaki Suit.
1 Riding Breeches.
1 Gaiters.
1 Helmet, Egyptian pattern.
1 Field-service Cap.
2 Pairs Boots, brown, walking.
1 Pair Shoes, brown, walking.
3 Shirts, flannel.
3 Drawers, cotton or silk.
2 Drawers, warm.
4 Vests, cool.
2 Vests, warm.
12 Pairs Socks, medium.
1 Jersey.
12 Handkerchiefs.
2 Pair Braces.
3 Sets Bootlaces and Dubbin.
1 Haversack.
1 Water-bottle, vulcanite.
1 Pasteur Filter (cork to fit bottle).
1 Holdall (razor, tooth-brush, etc.).
1 Valise (Wolseley).
3 Blankets.
1 Waterproof Sheet.
1 Folding Bath.
1 Basin, with leather cover to hold washing kit.
1 X bed.
3 Canvas Buckets.
Canteen for 3 or 2.
Pocket-case Surgical Instruments.
Hypodermic Syringe and Morphia tabloids.

APPENDIX P.

TRANSPORT (RECOMMENDED).

Transport sufficient for Local Purposes.

2 Ambulances, capable of carrying 4 lying-down cases each.
1 Watercart.
1 Trap.
5 Riding Horses and Saddlery.
8 Mules and Harness.

Extra mules available by requisition for occasional use.
Jack for raising wheels.
Tools for repairing.
Grease and Spun Yarn.

APPENDIX Q.

SICK STATISTICS—PORTLAND HOSPITAL.

Admissions, Discharges, Transfers, and Deaths, from 8th January to 21st July 1900.

Admissions.		Discharges.				Deaths.	Transfers to Base or other Hospitals.
		Duty.	Garrison Duty.	England.	Convalescent.		
Officers	119	50	2	7	7	2	51
N.C.O.'s & Men	890	103	4	91	296	35	361
Totals	1009	153	6	98	303	37	412

Officers and Men treated in the Portland Hospital on board ss. "Canada," Capetown to England, 1st August to 18th May.

	Transferred to Netley.	Transferred to Aldershot and other Hospitals.	Sick Furlough.
Officers	...	...	11
Men	15	25	31
Totals	15	25	42

Officers . 11
Men . . 71
82

C. R. KILKELLY,
Surgeon-Colonel, Grenadier Guards.

PORTLAND HOSPITAL.

Abstract of Admissions, Discharges, and Transfers at Rondebosch, from 8th January to 5th April 1900.

Admissions.		Discharges.				Deaths.	Transferred to other Hospitals.
		Duty.	Garrison Duty.	England.	Convalescent.		
Officers . . .	55	30	1	7	4	1	12
N.C.O.'s and Men	422	21	4	91	251	3	52
Totals .	477	51	5	98	255	4	64

BLOEMFONTEIN,
27th April 1900.

APPENDIX R

LIST OF DRUGS

These drugs, alphabetically grouped, were packed in cases 1 to 18, each case in duplicate. The equipment, therefore, comprised double the quantities mentioned below.

¼ lb. Acid. Sulph. Pur.
1 lb. Acid. Citric.
¼ lb. Acid. Gallic.
1 oz. Acid. Hydrocyan. Dil.
¼ lb. Acid. Phosphoric. Dil.
½ lb. Acid. Tannic.
2 lb. Acid. Tart. Pulv.
1 lb. Ammon. Bromid.
2 lb. Ammon. Carb., Opt.
1 lb. Acetanilid.
1 oz. Antim. Tart.
2 lb. Adeps. Lanæ. Hydrosus.
4 oz. Argent. Nit.
2 lb. Aqua Dest.
3 lb. Alum Pulv.
½ lb. Ammon. Chlor. Pur. Pulv.
½ lb. Alcohol Absolute.
1 lb. Acid. Hydrobrom. Dil.
1 lb. Acid. Hydrochlor. Dil.
1 lb. Bismuth. Carb.
1 lb. Boracis. Pulv.
4 oz. Butyl Chloral Hydrate.
4 oz. Beta Naphthol.
½ lb. Collodion.
1 lb. Camphora.
2 oz. Cera Alb. Pur., Cake.
1 lb. Chloral Hydras.
5 lb. Chloroform.
4 oz. Cocain Hydrochlor.
4 oz. Creasote.
1 lb. Cupri. Sulph. Pur.
½ gross Caps. Amyl. Nit.
2 oz. Caffein Cit.
¼ lb. Ext. Cinchon. Liq.
4 oz. Ext. Ergotæ Liq.
4 oz. Ext. Filicis Liq.
1 yd. Emp. Canthar.
1 yd. Emp. Saponis.
2 lb. Ext. Belœ Liq.
4 oz. Ext. Belladon. Virid.
½ lb. Ext. Cascaræ Liq.
1 yd. Emp. Belladon.
1 lb. Ext. Pareiræ Liq.
1 doz. 5 gr. Tubes Eserine.
1 lb. Ferri et Quin. Cit.
½ lb. Ferri et Ammon. Cit.
1 lb. Ferri Carb. Sacch.
4 lb. Glycerine.
1 doz. 5 gr. Tubes Homatropine.
8 oz. Hydrarg. Perchlor. Pulv.
1 lb. Hydrarg. Subchlor. Pulv.
½ lb. Inf. Buchu Conc. (1-7).
4 oz. Inj. Morph. Hypoderm.
2 lb. 8 oz. Iodoform.
1 lb. Ipecac. Pulv.
1 lb. Inf. Gent. Co. Conc.
½ lb. Inf. Cocain Hydroch.
4 oz. Liq. Epispasticus.
½ lb. Liq. Iodi. Fort.
½ lb. Lin. Aconit. Meth.
½ lb. Lin. Belladon. Meth.
3 lb. Lin. Camph. Co.
2 lb. Lin. Saponis. Meth.
2 lb. Liq. Ammon. Fort.
2 lb. Liq. Ammon. Acet. Fort.
½ lb. Liq. Arsenicalis.
½ lb. Liq. Arsen. et Hyd. Iodid.
2 lb. Liq. Ferri Perch. Fort.
½ lb. Liq. Opii Sed.
1 lb. Liq. Plumbi. Subacet.
1 lb. Liq. Potassæ.
½ lb. Liq. Picis. Carb.
2 lb. Liq. Quassia Conc. (1-9).
½ lb. Liq. Strychninæ Hydroch.

LIST OF DRUGS—*Continued*

$\frac{1}{2}$ lb. Liq. Calumbæ Conc. (1-9).
4 oz. Liq. Arsenic. Hydroch.
$\frac{1}{2}$ lb. Liq. Senegæ Conc. (1-9)
2 lb. Lin. Pot. Iodid. c. Sapon.
5 lb. Magnes. Sulph. Opt.
$\frac{1}{2}$ oz. Morphinæ Hydrochlor.
2 lb. Mist. Senna Co. Conc.
2 lb. Ol. Terebinth.
$\frac{1}{2}$ lb. Ol. Copaibæ.
1 oz. Ol. Crotonis.
2 oz. Ol. Menth. Pip.
4 lb. Ol. Olivæ.
4 lb. Ol. Ricini.
2 oz. Opii. Pulv.
2 lb. P. Rhei Co.
5 gross Pil. Hyd. c. Creta, gr. 2.
2 lb. Paraffin Molle.
3 x 2 lb. Paraffin. Molle Boric (1-6).
1 lb. Paraffin. Molle c. Hyd. Ox. Rub. (4 gr. to oz.).
$\frac{1}{2}$ lb. Phenacetine.
5 gross Pil. Hydrarg., gr. 5.
5 gross Pil. Rhei Co., gr. 5.
2 gross Pil. Ipecac. c. Scilla., gr. 5.
$\frac{1}{4}$ lb. Pot. Caustica.
16 oz. Phenazone.
1 lb. Pot. Bromid.
2 lb. Pot. Chlor.
2 lb. Pot. Iodid.
2 lb. Pot. Nit. Pulv.
$\frac{1}{2}$ lb. Pot. Tart. Acida.
5 lb. Pot. Permang.
1 lb. P. Cretæ Arom.
2 lb. P. Cretæ Arom. c. Opio.
1 lb. P. Ipecac. Co.
1 lb. P. Jalapæ Co.
1 Stopper Loosener Pannier.
1 Copy P. B., 1898.
1 Copy Martindale.
$1\frac{1}{2}$ doz. Gallipot's Nested Pannier.
2 gross Pil. Scammon. Co.
5 gross Pil. Plumbi c. Opio.

40 oz. Quininæ Sulph., Compressed.
40 oz. Quininæ Sulph., 2 gr. Tabs.
1 lb. Spts. Ætheris.
2 lb. Spts. Ætheris Nit.
1 oz. Santonine.
3 lb. Sinapis Pulv.
3 Boxes Sinapis Charta Rigollots.
4 lb. Sodii Bicarb.
2 lb. Sodii Salicylas.
4 lb. Spts. Ammon. Arom.
4 lb. Spts. Chloroform.
4 pts. Spts. Vini. Meth.
3 lb. Sanitas.
4 pts. Spts. Vini. Rect.
2 lb. Syr. Scillæ.
1 gross Suppos. Bella., P. B. gr. $1\frac{1}{2}$.
1 gross Suppos. Morph., P. B. gr. $\frac{1}{2}$.
600 Tabs. Tabellæ Atropin. Sulph., gr. $\frac{1}{100}$.
500 Tabs. Morphinæ Tart., gr. $\frac{1}{8}$.
500 Tabs. Morphinæ Tart., gr. $\frac{1}{4}$.
$\frac{1}{2}$ lb. Tabs. Sulphonal., gr. 5.
4 oz. Tinct. Aconit.
4 oz. Tinct. Arnicæ.
2 lb. Tinct. Aurant.
$\frac{1}{2}$ lb. Tinct. Belladon.
$\frac{1}{2}$ lb. Tinct. Benzoin. Co.
2 lb. Tinct. Camph. Co.
4 oz. Tinct. Capsici.
1 lb. Tinct. Cardam. Co.
1 lb. Tinct. Catechu.
1 lb. Tinct. Chlorof. et Morph.
2 lb. Tinct. Cinchon. Co.
$\frac{1}{2}$ lb. Tinct. Colchici Sem.
1 lb. Tinct. Digitalis.
1 lb. Tinct. Hyoscyam.
1 lb. Tinct. Iodi.
$\frac{1}{2}$ lb. Tinct. Myrrhæ.
1 lb. Tinct. Nuc. Vom.
4 lb. Tinct. Opii.
1 lb. Tinct. Rhei, P. B.
1 lb. Tinct. Scillæ.

LIST OF DRUGS—*Continued*

½ lb. Tabellæ Trinitrinæ.
½ lb. Tabellæ Salol., gr 5.
4 oz. Tinct. Cannab. Ind.
½ lb. Tinct. Hamamelidis.
1 lb. Ung. Sulphur. Co.
1 lb. Ung. Zinci.
1 lb. Ung. Hydrarg.
½ lb. Ung. Hydrarg. Nit. Dil.
½ lb. Ung. Hydrarg. Ox. Flav.
1 lb. Ung. Resinæ.
2 lb. Ung. Acid. Boric.
2 lb. Ung. Paraffin. Flav.
2 lb. Ung. Hydrarg. Ammon.
1 lb. Ung. Hydrarg. Comp.
½ lb. Ung. Hydrarg. Oleat.
2 lb. Vin. Antim.
2 lb. Vin. Ipecac.
8 oz. Zinci Chlor. Sticks.
1 lb. Zinci Oxid.
1 lb. Zinci Sulph. Pur.
½ lb. Zinci Sulpho-Carb.
1 doz. Bottles, 4 oz.
2 doz. Bottles, 6 oz.
1½ doz. Bottles, 8 oz.
½ doz. Bottles, 12 oz.
1 doz. Bottles, 1 oz. Fluted Poison.
1 doz. Bottles, 2 oz. Fluted Poison.
1 doz. Bottles, 4 oz. Fluted Poison.
1 doz. Bottles, 6 oz. Fluted Poison.
½ doz. Bottles, ½ oz. Vial.
1 doz. Bottles, 1 oz. Vial.
1 doz. Bottles, 2 oz. Vial.
1 × Bolus Tile, large.
1 × Bolus Tile, small.
3 papers Boxes, Pill Chip.
2 papers Boxes, Pill Paper.
2 gross Corks, vial.
2 gross Corks, ½ pint.
1 gross Corks, pint.
1 gross Corks, quart.
¼ quire Filtering Paper.
500 Labels, Blank.
200 Labels, "External Use."
300 Labels, "Poison."
200 Labels, "Shake the Bottle."
300 Labels, Ward.
2 yds. Straining Cloth.
2 oz. Packthread.
2 Measures, grad. minim.
2 Measures, grad. 2 oz.
3 Measures, grad. 4 oz.
1 Measure, grad. ½ pint.
1 Measure, grad. pint.
2 Evaporating Basins.
1 Funnel, Compo.
2 Funnels, Glass.
2 Funnels, Tin.
1 Pestles and Mortars, Compo., sm.
1 Pestles and Mortars, Compo., medium.
1 Pestles and Mortars, Glass.
2½ gross Pil. Coloc. et Hyoscyam.
2 lb. Acaciæ Pulv.
8 lb. Acid. Boric. Pulv.
2 lb. Acid. Carbolic. Xts.
10 lb. Acid. Carbolic. Liq.
4 oz. Acid. Acetic. Glac.
5 lb. Æther, ·720.

LIST OF APPLIANCES

500 Loose Wove Bandages, Sal Alem.
2 Doz. Suspensory Bandages.
2 Doz. Triangular Bandages, Sal Alem.
2 Bandage Rollers.
5 C.H. Pencils, bent.
15 C.H. Pencils, straight.
20 yds. Thin Calico.
25 yds. Christia Tissue.
12 Tubes, Drainage-Tubing in Aseptic Solution.

LIST OF APPLIANCES—*Continued*

250 Bandages, Gauze, Dble. Cyanide.
40 lb. Cotton Wool Absorbent.
12 lb. Cotton Wool Double Cyanide, in 2 oz. packets.
6 lb. Cotton Wool, Alembroth, in 4 oz. packets.
14 Single Eye-shades.
6 Eye-shades, Double.
6 Vulcanite Idioform Dredgers.
2 Gutta-percha Idioform Dredgers.
25 yds. Jaconet Waterproof.
2 Leather Skins.
6 Packets Common Pins.
40 Boxes Safety Pins.
30 Boxes Fine Lint.
12 yds. Poultice Cloth.
6 yds. Sheeting, Bleached Linen.
12 Old Linen Sheets.
25 Tubes, Silk, twisted five inch, in Aseptic Solution.
6 Reels Ligature Silk.
2 Syringes, Male, Pewter.
24 Syringes, Male, Glass.
6 Pieces Broad Tape.
6 Pieces Narrow Tape.
100 Pieces for Field Equipment.
8 oz. Thread for Ligatures.
6 Books Test Papers.
6 Sets Test Tubes.
12 yds. Waterproof Cloth.
4 Eye Baths.
6 Corkscrews, Folding.
2 Caustic Holders.
1 Knife, Bolus, 6-inch.
4 Leather Arm Slings.
1 Small Air Bellows.
3 Air Pillows, Round.
3 Air Pillows, Square.
15 lb. Tenax.
25 lb. Marine Lint.
60 lb. Surgeon's Tow.
2 Air Bed Boxes, complete.
6 Cradles, Fracture, Iron Portable.
24 Catheters, Olivary.
24 Catheters, E.G.
12 Bougies, Olivary.
2 Bags, Ice, Spine.
2 Hones, Turkey.
2 Hones, Arkansas Slip.
2 Sets of Irrigators, 2 in a set.
6 Glass Rods.
4 Slings, Arm, Wire.
2 Screwdrivers.
2 Scissors, Counter.
1 Set Scales & Weights, Brass Pan.
1 Set Scales & Weights, Glass Pan.
2 Sets Pillar Scales.
1 Set Ounce Scales.
2 Spatulas, Bone.
2 Spatulas, Spreading.
12 yds. Tubing, Drainage.
2 Machines, Pill.
2 Tapes, Measuring, Chesterman's Spring.
6 Sets Common Splints.
4 Salter's Cradles.
2 Straps.
1 Apparatus Urinometer, Small.
6 Pillows, Stump Waterproof.
12 Glass Ear Syringes.
2 Thermometers, Bath.
1 Tourniquet Screw.
1 Apparatus, Enema, Brass.
1 Set Catheters, Silver and Nickel.
2 Aluminium Stethoscopes.
1 Stomach Pump.
24 Thermometers, Clinical in B. C. Cases.
2 General Fracture Boxes, complete.
1 Thomas's Hip Splint, adult size.
1 Patten for Thomas's Splint.
4 Water-Bottles, c. Felt Covers.
100 yds. Flannelette.

LIST OF APPLIANCES—*Continued*

6 Higginson's Enemas, c. Bone Nozzles.
6 Higginson's Enemas, c. Glass Nozzles.
4 Doz. Spare Glass Nozzles.
16 Lapis Divinus Points.
2 Holders for ditto.
80 lb. Chloroform in Stop. and Cap. Bottles.
30 lb. Ether in Stop. and Cap. Bots.
12 Drop Bottles.
9 Pairs M'Burney's Gloves.
3 Trays, Enamelled Iron.
6 Basins, 14-inch.
24 Lane's Screws.
30 Ivory Pegs for Bone Sutures.
1 File, 6-inch.
1 Aseptic Brace, c. 9 Twist Drill.
3 Pins, Steel Patella.
1 Screwdriver, Lane's, all Metal.
4 Sounds, Clutton's, four sizes.
3 Bone Drills, N.-P. Metal Handles.
1 Combined Sterilizer, Fig. 2628.
2 Infusion Canulas, Silver.
1 Infusion Canula, Steel.
100 ft. White Pine for Splints.
100 ft. Iron for Splints.
6 Assorted Glass Funnels.
12 lb. Carbolic Acid Cryst., B.P.
3 20-oz. Measures, grad. cylin.
3 40-oz. Measures, grad. cylin.
6 2-oz. Measures, grad. cylin.
200 Infusion Tabloids.
2 lb. Olive Oil.
132 yds. Grey Scourer.
1 Berkfeld Filter.
6 Spare Cylinders for ditto.
24 Ligature Holders, Metal, to pat.
4 Operating Blouses.
2 Antiseptic Cases, complete.
Bandages, Loose Wove, Salalembroth.
Bandages, Suspensory.
Bandages, Triangular, Salalembroth.
Bandages, Rollers for.
Camel Hair Pencils, bent.
Camel Hair Pencils, straight.
Calico, thin.
Christia Tissue.
Drainage Tubing, in Aseptic Solution.
Bandages, Gauze, Double Cyanide.
Cotton Wool, Absorbent.
Cotton Wool, Double Cyanide, 2 oz. packets.
Cotton Wool, Salalem., 4 oz. packets.
Eye-shades, single.
Eye-shades, double.
Dredgers, Iodoform, Vulcanite.
Gutta percha, for Splints.
Jaconet Waterproof.
Leather Skins.
Pins, Common.
Pins, Safety, Boxes of 50.
Lint, fine.
Poultice Cloth.
Sheeting, Bleached Linen.
Sheets, Old Linen.
Silk, Twisted, fine and medium, in Aseptic Solution.
Silk Ligature, on Reels.
Syringes, Male, Pewter.
Syringes, Male, Glass.
Tape, broad.
Tape, narrow.
Tape, for Field Equipment.
Thread, for Ligatures.
Test Papers.
Test Tubes.
Waterproof Cloth.
Eye Baths.
Corkscrews, Folding.

LIST OF APPLIANCES—*Continued*

Holders, Caustic.
Knife, Bolus, 6-inch.
Slings, Arm, Leather.
Air Bellows, small.
Air Pillows, round.
Air Pillows, square.
Tenax.
Tow, Surgeon's.
Air-bed Boxes, complete.
Cradles, Fracture, Iron portable.
Catheters, Olivary.
Catheters.
Bougies, Olivary.
Bags, Ice, Spine.
Hones, Turkey.
Hones, Arkansas Slip.
Irrigators, sets of 2 complete.
Rods, Glass.
Splints, Wire Arm.
Screwdrivers.
Scales and Weights, Brass Pan.
Scales and Weights, Glass.
Scales and Weights, Pillar.
Scales and Weights, Ounce.
Tubing, Drainage.
Machines, Pill.
Splints, Common.
Splints, Salter's Cradles.
Strops.
Apparatus, Urinometer, small.
Pillows, Stump, Waterproof.
Glass Ear Syringes.
Thermometers, Bath.
Tourniquet, Screw.
Apparatus, Enema Brass.
Catheters, Silver and Nickle.
Stethoscopes, Aluminium.
Stomach Pump.
Thermometers, Clinical, in bayonet catch cases.
General Fracture Boxes.
Thomas's Hip Splint, adult size.
Medical Companion.
Surgical Haversacks.
Water Bottles, c. Felt Covers.
Flannelette.
Higginson's Enemas, c. Bone Nozzles.
Higginson's Enemas, c. Glass Nozzles.
Glass Nozzles, spare.
Chloroform, in 2 lb. bottles.
Ether, in 1 lb. bottles.
Drop Bottles.
M'Burney's Gloves.
Trays, Enamelled Iron.
Basins, Enamelled Iron, 14-inch.
Lane's Screws.
Ivory Pegs for Bone Sutures.
File, 6-inch.
Aseptic Brace, N.-P., c. 9 Twist Drill.
Pins, Steel Patella.
Bone Drills, metal handle.
Combined Sterilizer.
Infusion Canulas, Silver.
Wood, White Pine.
Iron, as used in Hip Splints.
Funnels, Glass, assorted.
Carbolic Acid Cryst., B.P.
Measures, graduated cylindrical, 20 oz.
Do., do., 40 oz.
Do., do., 2 oz.
Infusion Tabloids.
Olive Oil.
Grey Scourer.
Blouses, Operating.
Scissors, Counter.
Spatulas, Bone.
Spatulas, Spreading.
Tapes, Measuring, Chesterman's Spring.
Ligature Holders, Metal.

LIST OF APPLIANCES—*Continued*

Pattern for Thomas Splint.
Marine Lint.
3 Amputation Knives, 6-inch.
3 Amputation Knives, 8-inch.
3 Ankle Joint Knives.
2 Amputation Saws.
2 Amputation Saws, small.
1 Amputation Saw, Butcher's.
2 Metacarpal Saws.
48 Wells' Forceps.
4 Spring Dressing Forceps.
1 Small Needle Holder.
3 Large Needle Holders.
2 Bullet Forceps.
2 Gunshot Probes.
3 Bone Forceps.
2 Bone Forceps, angular.
3 Bone Gouges.
1 Bone Cutting Scissors.
3 Bone Chisels.
1 Lion Forceps.
2 Gouge Forceps.
4 Necrosis Forceps.
6 Tooth Forceps.
1 Parrot-bill Forceps.
6 Bottles Dental Liquid.
2 Elevators.
3 Esmarch's Tourniquets.
2 Raspatories.
Brain Searcher.
4 Aneurism Needles.
2 Bistouries.
2 Bistouries, sharp.
4 Finger Knives.
4 Hernia Knives.
48 Scalpels.
24 doz. Needles.
2 doz. Hanks Silk.
1 doz. Hanks Silk.
2 doz. Hanks Catgut.
6 doz. S. W. Gut.
3 Kangaroo Tendons, in bottle.
12 Hanks Silver Wire.
Wire-cutting Forceps, plated.
4 Large Retractors.
4 Double Blunt Hooks.
2 Liston's Needles.
2 Liston's Needles.
2 Hernia Directors.
12 Pairs Dissecting Forceps.
3 Pairs Dressing Forceps.
2 Pairs Rat-Tooth Forceps.
3 Pairs 5-in. Sharp-pointed Scissors.
3 Pairs 5-in. Blunt-pointed Scissors.
3 Pairs 5-inch Angular Scissors.
3 Pairs Curved Scissors.
2 Scissors, Long-pointed, Straight.
1 Set Trephines.
6 Volkmann's Spoons.
1 Eye Case.
1 Laryngoscope.
2 Ward Scissors, 8-inch.
2 Ward Scissors, 9-inch.
Clover's Crutch.
Junker's Inhaler.
Ophthalmoscope.
Nasal Speculum.
2 Fergusson's Gags.
4 Tongue Depressors, 2 sizes, large and small.
2 Vulsellum Forceps.
2 Trachea Tubes.
2 Trachea Dilators in case.
Aspirator.
Exploring Syringe.
2 Trocars and Canulas.
3 Hypo. Syringes.
2 Clover's Inhalers, with spare bags.
Chloroform Inhaler.
3 Long Pressure Forceps.
6 Sponge-holding Forceps.
3 Sponge Holders.
1 Bladder Trocar.
1 Case Lister's Bougies.

LIST OF APPLIANCES—*Continued*

1 Rectal Speculum.
Tongue Forceps.
12 Assorted Probes.
12 Assorted Directors.
Blunt Dissector.
File Forceps.
2 Mallets.
24 Steel Pins.
Bradawl.
Screwdriver.
2 Intestinal Clamps.
12 Razors.
24 Nail Brushes.
2 Infusion Apparatus.
3 Murphy's Buttons.
3 Glycerine Syringes.
3 I. R. Œsophagus Tubes.
1 Set Leiter's Coils.
2 Fracture Cradles.
12 Straps.
2 Body Cradles.
3 Bed Cradles.
3 Pieces Splinting.
6 lb. Guttapercha.
2 Ice Caps.
2 Bed Rests.
6 Sets Lined Splints.
12 doz. Safety Pins.
6 doz. 1-inch Calico Bandages.
24 doz. 3-inch Calico Bandages.
6 doz. 6-inch Calico Bandages.
36 doz. 3-in. Calico Bandages, O.W.
4 doz. 4-inch Flannel Bandages.
2 doz. 6-inch Flannel Bandages.
4 doz. 4-inch Domette Bandages.
6 doz. 3-in. Plaster Paris Bandages.
6 Tins Plaster Paris.
18 Spools Plaster, 1 inch.
18 Spools Plaster, 2 inch.
12 Spools Plaster, 3 inch.
12 Bottles Drainage Tubing.
12 yds. Drainage Tubing.
4 doz. Honeycomb Sponges.
6 Abd. Sponges.
2 doz. Turkey Sponges.
2 Bottles Zimocca Sponges.
36 yds. Carbolized Gauze.
1000 yds. Cyanide Gauze (6 yds.).
500 yds. Plain Gauze.
48 lb. Gamgee Tissue.
24 yds. Iodoform Gauze.
300 yds. Thymol Gauze.
30 lb. Lint.
2 Pieces Sheeting, 9 ft. × 3 ft. 6 in.
4 Pieces Sheeting, 54 in. × 48 in. (5 yds. 1 ft.).
24 yds. Pink Jaconet.
12 lb. Boracic Lint.
400 lb. Absorbent Wool.
3 Inst. Tables.
2 Operation Tables.
4 Boxes for Dressings.
2 Sterilizers.
2 Ligature Troughs.
4 Sponge Jars.
4 Solution Jars, 3 galls.
4 Solution Bowls.
4 Solution Bowls.
2 Sets 3 Dressing Trays.
4 Inst. Trays.
4 Inst. Trays.
18 Bed Pans.
6 Urinals.
4 Solution Jars, 2 galls.
6 Tube Clips, large.
22 Bottles of Mercuric Chloride.
20 lb. Carb. Acid Crystals.
8 yds. Tubing for Solution Jars.
2 doz. Tubes Eucaine.
1 doz. Tubes of Cocaine.
3 doz. Tubes Glass Reels.
12 Blocks.
24 yds. Cords.
2 doz. Pulleys.

APPENDIX S

STATEMENT OF ACCOUNTS OF

March

To Subscriptions, as per list appended - - -	£13,647	10	3
,, Interest received on Deposit Account - - -	43	5	11
	£13,690	16	2

APPENDIX S

THE PORTLAND HOSPITAL

1901.

	£	s.	d.	£	s.	d.
By Hospital Equipment—						
Ambulance Waggons, etc. - -	£826	2	6			
Tortoise Tents, etc. - - -	554	5	0			
Medical and Surgical Appliances, Filter, Röntgen Ray Apparatus, etc. - - - - - - -	888	19	11			
Bedsteads, Blankets, Linen, Hardware, and Crockery, etc. - -	773	2	6			
	£3,042	9	11			
Less—Equipment, etc., sold in S. Africa	2,322	10	10			
				£719	19	1
„ Provisions, Mess Stores, and Hospital Comforts - - - - - - - -				976	9	2
„ Salaries, Gratuities, and Expenses of Personnel—						
Salaries of Medical Staff - -	£3,860	0	0			
Salaries of Nurses - - - -	109	12	6			
Wages of Orderlies - - - -	809	19	4			
Gratuities (including £20 given to H. Borer Memorial Fund) - -	1,191	6	4			
Allowances for Expenses to Nursing Staff prior to leaving England -	66	0	3			
Fares and Passages of Nurses (not provided by Government) - -	251	11	8			
Insurance of St John's Ambulance Men - - - - - - -	312	9	0			
				6,600	19	1
„ Expenses in England, including Clerical Help, Stationery, Printing, Fares, and General Sundries - - - - - - - -				255	7	0
„ Packing, Carriage, Transport, and Insurance of Goods - - - - - -				237	11	7
„ Cash Remitted to South Africa for Current Expenses, Wages, etc. - - - - -				1,808	0	0
				£10,598	5	11
„ Balance—						
Cash on Deposit at Bank -	£2,500	0	0			
Cash at Bank - - - - - -	563	6	2			
Cash in Hands of Williams' Agency	29	4	1			
				3,092	10	3
				£13,690	16	2

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THE END.

OLIVER AND BOYD, PRINTERS, EDINBURGH